FEBRUARY, 1934

METALS & ALLOYS

PRODUCTION — FABRICATION — APPLICATION

INCLUDING

CURRENT METALLURGICAL ABSTRACTS

Metals & Alloys, published monthly by The Chemical Catalog Company, Inc. Publication office: 1117 Wolfendale St., Pittsburgh, Pa. Executive offices: 330 West 42nd St., New York, N. Y. Entered as second class matter March 14, 1932, at the Post Office at Pittsburgh, Pa., under the Act of March 3, 1879. \$3.00 a year in U. S.; foreign, \$8.00. Vol. 5, No. 2.

METALS & ALLOYS

The Magazine of Metallurgical Engineering

devoted to

Production — Fabrication — Application

PUBLICATION OFFICE:
1117 Wolfendale St., Pittsburgh, Pa.

H. W. GILLETT, Editorial Director
Battelle Memorial Institute,
Columbus, Ohio

RICHARD RIMBACH, Editor

WM. P. WINSOR, Advertising Manager

EDITORIAL AND ADVERTISING OFFICES:
330 West 42nd St., New York, N. Y.

BRANCH OFFICE:
706 Straus Bldg., Chicago, Ill.
G. E. Cochran **R. M. Creaghead**

PUBLISHED MONTHLY BY
THE CHEMICAL CATALOG COMPANY, INC.

Ralph Reinhold, Pres.-Treas.
Philip H. Hubbard, Vice-Pres.
H. Burton Lowe, Vice-Pres.
Francis M. Turner, Vice-Pres.

Annual Subscription: U. S., Possessions; $3.00; Canada, $4.00; All Other Countries, $8.00 (Remit by New York Draft). All communications relating to subscriptions or back issues should be addressed to METALS & ALLOYS, 330 West 42nd St., New York, N. Y.

Entered as second-class matter March 14, 1932, at the post office at Pittsburgh, Pa., under the Act of March 3, 1879.

CONTENTS · FEBRUARY, 1934

CURRENT METALLURGICAL ABSTRACTS

HIGHLIGHTS

by H. W. GILLETT

DO YOU want to know what metallurgical engineers are saying, the world over? Look in the Current Metallurgical Abstracts. Here are some of the points covered by authors whose articles are abstracted in this issue.

Reading Technical German

Knowing what the German words mean is more than half the battle in reading technical German, putting them together to make sense isn't so difficult if you know the vocabulary. We wonder if the giving of both the English and the German of the titles of German articles abstracted isn't rather painlessly enlarging the vocabulary of a lot of readers.

Wear of Cast Iron

Four kinds of wear tests of cast iron were made by Heimes & Piwowarsky (page MA 47 L 9), from which they conclude that phosphide and free cementite help when cast iron rubs against steel, but harm when it rubs on other cast iron.

Solidification of Steel

Ingot molds and the freezing of steel ingots get attention by Berglund & Johannson (page MA 61 R 4), Schwarz (page MA 61 R 6), Roth (page MA 61 R 10), Ristow (page MA 61 L 1), Jacob (page MA 61 L 7), Heggie (page MA 62 L 1), Kohira (page MA 61 L 6) and Firth (page MA 62 L 2).

Rail-End Wear

Sec. 11c (page MA 54 R 9 and 10, page MA 55 L 1) covers wide use of rails and crossings by Illinois Central, New York Central, Central of Georgia, New Haven and Lehigh Valley with particular attention to worn rail ends and to Mn steel. An observation from the Illinois Central experience with gas welding (page MA 54 R 8) indicates that the welded rail joints harden up more by the cold working action of the wheels than the regular rail does.

Aluminum Cast Iron for Corrosion and Heat Resistance

Piwowarsky & Söhnchen (page MA 70 R 8) like the corrosion- and heat-resistant properties of cast iron with 10 to 20% aluminum. Scaling, even up to 1100° C., is negligible and if the castings are allowed to grow cold in the mold, the castings don't crack on subsequent heating.

Welding of Cast Iron

Giessereipraxis (page MA 54 R 3) has an article discussing when cast iron may properly be welded. *Welder* has one on use of nidal cast iron welding rods at a Scotch plant (page MA 54 R 5). Bronze welding of exhaust manifolds on Diesel engines is described (page MA 55 R 2). One of those unsatisfactory articles that tell what wonderful results can be had from some trade-named German material (page MA 56 R 6) makes claims for fine welding of cast iron. *Soudure Autogene* (page MA 56 L 2) states that by beveled joints, sand blasting and removal of graphite, good welds can be had in cast iron. Three Russians (page MA 56 L 5) check up on a Japanese method which they say works, but they don't like NiCu electrodes for cast iron. Roberts, however (page MA 55 R 2) is strong for NiCu for welding cast iron. Zorn (page MA 55 R 4) deals with flame cutting of cast iron. It looks as though the welders are not going to confine their operations to steel.

Chlorine and Condenser Tubes

Helping condenser tubes by introducing chlorine into the cooling water sounds odd, but Boucher (page MA 41 L 10) advocates it, in amount too small to cause corrosion, but sufficient to discourage micro-organisms that produce a coating of low thermal conductivity.

Vacuum Melting

Vacuum melting for base metal thermocouple alloys is considered by Grunert (page MA 71 L 8) as highly important for maximum life and stability.

Brittleness

Messkin & Margolin (page MA 70 L 3) describe brittleness in Si transformer sheet from exposure to hydrogen at high temperatures analogous to the embrittlement of oxygen-bearing copper. Lewkonja & Baukloh (page MA 70 L 6) find that carbon steel is the more permeable to hydrogen at high temperatures in higher carbon contents. A thin Al coating on the steel made it impermeable.

No Welding on Steel Structures

Hollis (page MA 55 R 10) remarks that England still prohibits welding on steel structures more than one story high!

Titanium as an Alloy

Titanium as an alloy, not merely as a scavenger, improves plain carbon steel but not the low alloy Cr and Ni-Cr steels, say Arend & Lobe (page MA 70 R 1).

Ferro-Manganese Introduces Gases

Bardenheuer (page MA 60 R 5) tells us that gases are introduced into steel by FeMn and other alloys. They may carry in something like 10 times their own volume of gas.

Bronzes for High Temperature Service

About 3% Si is said (page MA 71 R 3) to replace about 3 times its weight of Sn in high-tin bronzes or Ni-Cu bronzes with a very marked increase in strength at high temperatures.

Beryllium-Copper-Nickel Alloys

We hear a lot about copper-beryllium alloys, but Masing & Pocher (page MA 38 L 10) find that CuNi alloys require less Be than straight Cu and retain strength at high temperatures.

Open-Hearth Regenerators

Thirty pages in the Journal of the British Institute of Fuel (page MA 68 R 1) deal with design and operation of open-hearth regenerators.

EDITORIAL COMMENT

Everybody's Business

WHEN AN engineering problem comes up which confronts a considerable number of producers and users equally, there are two ways to attack it, the individual method and the joint method. If a reasonable program of investigation for its solution is estimated to cost, say, $30,000 and any one firm discusses the appropriation of that sum, somebody is likely to suggest that, since 9 other firms are equally concerned in finding the solution, they should pool their interests and each spend but $3,000.

The outcome is very likely to be a request to some suitable committee of a technical society to take the matter over and see if it can't interest the 9 others. Failing the existence of such a committee, a special one, either independent or affiliated with one or more societies, has to be created. This committee has to formulate its program, a matter 10^{10} times as difficult with 10 sets of advisers than it is with one, and then has to finance its program, a task which any finance sub-committee with experience in such matters will agree is a very mean one, since action by so many boards of directors is called for.

A certain proportion of those who would profit by a solution of the problem may figure that the others will do the job anyhow and that they will ultimately get the dope without helping pay for it. What is everybody's business is too often nobody's business, and the ratio of those who reasonably should join the project to those who actually do is likely to be disappointing. Worst of all, the committee machinery is almost invariably ponderous and slow, so much delay ensues.

Speller has proposed a set-up whereby, in the ferrous industries the job of selling the idea of support of such problems of joint interest be undertaken once and for all, and appropriations be made for the support of such joint problems as may arise, and the funds be at the disposal, say, of the Iron and Steel Institute, which would set up a committee to pass upon the importance of the project and its deserts as to support in comparison with other projects. Were such a mechanism in existence, once this committee approved the project, financing would be assured by that approval and the wheels would begin to turn far more rapidly. This Utopian plan, were some of its pitfalls intelligently avoided, would certainly have advantages. But it isn't yet operating and we have to deal with conditions as they are, not as they might be.

We have had enough personal experience with joint projects to have some very definite ideas as to the types that will be fruitful under joint attack. We believe that those which deal with improvement in existing manufacturing processes or with the direct development of improvements in alloys for a specific purpose are more likely to show results under individual attack by single firms or, in some cases, by small closely-knit groups, with no obligation to share the results with a wide circle of competitors. Those that are normally suited for joint study fall chiefly into the category of the determination of the properties of materials now being produced by many firms. Here the producers and the users need to get the facts that underlie just purchase specifications and sane engineering application of the materials to service. Specifications in general and, more particularly, methods of testing absolutely require widespread approval and acceptance before they are useful. No one firm can impose its own specifications or test methods to the exclusion of all others until they have been checked up and approved by joint study.

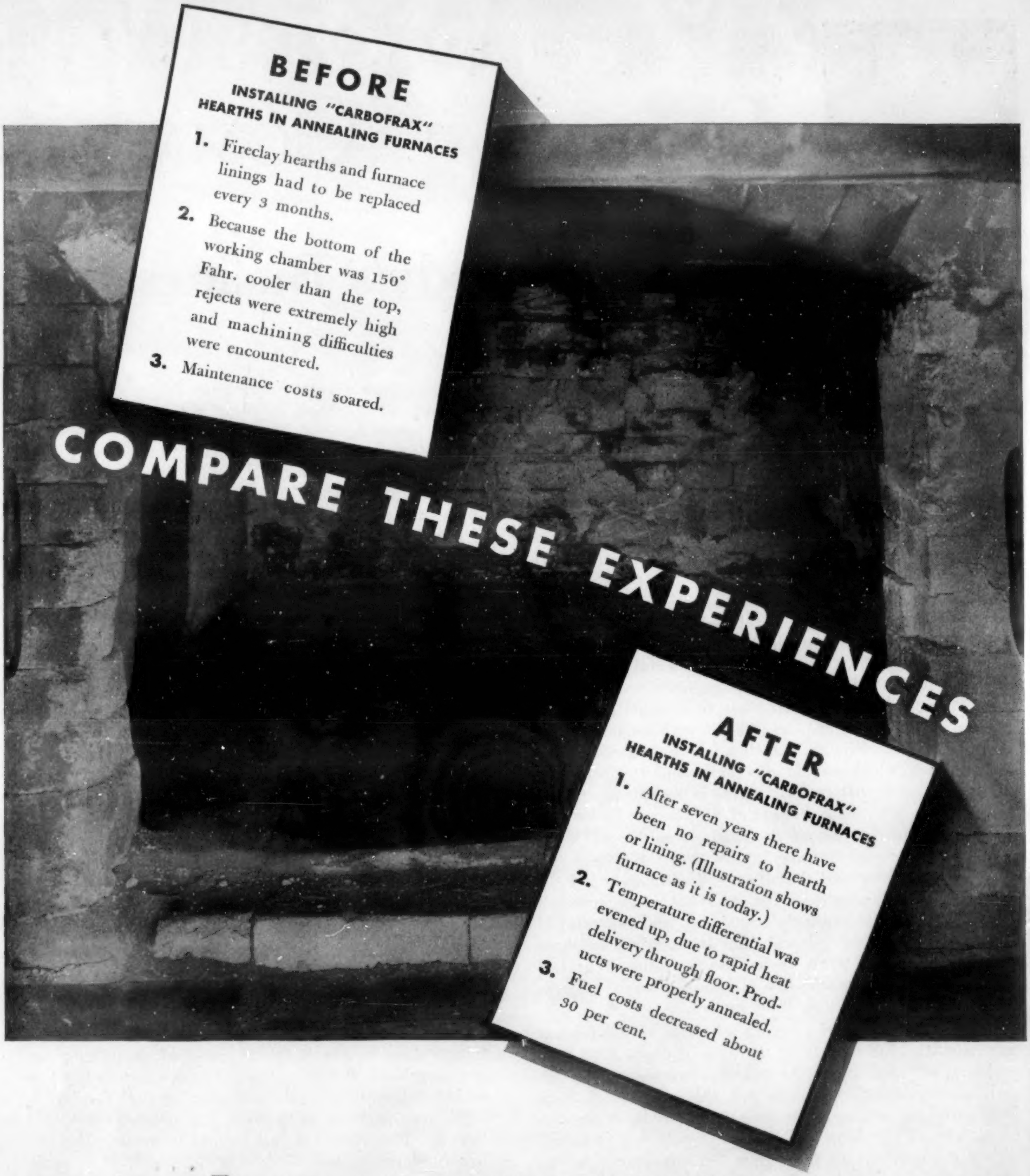
When a project is truly of the type that demands joint action, much time is saved if there is already an active and experienced technical committee in existence which can plan the experimental program, carry it out, and report the results under such auspices that they carry immediate weight and deserve universal credence.

A field which is clearly one calling for joint action is that of the properties of metals at high temperatures. It has been universally so appraised. Joint committees have been set up in this field, first in the United States, later in England, and more recently in France and Belgium. In Germany there is much activity, with coöperation made rather automatic by the set-up of German industry and its relations to the various metallurgical societies. The English group has recently agitated for the support of a three-year experimental program of high-temperature research to the tune of something corresponding to $50,000, putting its plea for support on a rather nationalistic basis and arguing that foreign competition is so keen as to make it a patriotic duty to see that England does not fall behind in getting and utilizing fundamental knowledge in this field. It is actively supported by the engineering press of Britain[1] and the reports indicate that there will be no difficulty in financing the English program through both industrial and government support.

In the U. S. government effort in this line has been curtailed[2] and, though the administration is lavishly throwing funds into this and that project aimed at relief of both the worthy and the shiftless, no use of public funds for forward-looking technical and engineering advancement of this type seems to be on the cards. The problem here is, therefore, quite definitely up to industry.

[1]Editorials. *The Engineer*, Dec. 1, 1933, pages 549, 542, 543, 554; *Engineering*, Dec. 1, 1933, pages 603-604.
[2]See *Metals & Alloys*, Sept. 1933, page 136.

Continued on page 42)



THIS is the experience of a famous New England tool manufacturing plant. Other users report similar advantageous results. Perhaps our engineers can be useful to you.

"CARBOFRAX"

REG. U. S. PAT. OFF.

The Carborundum Brand Silicon Carbide Refractory

BRICK · TILE · MUFFLES · HEARTHS · CEMENT

THE CARBORUNDUM COMPANY (Refractory Division) Perth Amboy, N. J. District Sales Branches: Chicago, Cleveland, Detroit, Philadelphia, Pittsburgh. Agents: L. F. McConnell, Birmingham, Ala.; Christy Firebrick Company, St. Louis; Harrison & Company, Salt Lake City, Utah; Pacific Abrasive Supply Co., Los Angeles, San Francisco, Seattle; Denver Fireclay Co., El Paso, Taxas; Williams and Wilson, Ltd., Montreal-Toronto, Canada. (Carborundum and Carbofrax are registered trade marks of The Carborundum Company).

RESEARCH PAYS PROFITS

Experiences in Successful and Unsuccessful Research

by H. W. Gillett*

IN last month's Editorial on Executive Control of Research for Profits, there was promised a series of "case histories" showing how the conditions set up by the executive make for the success or the failure of a research project, and pointing out the importance of considering economic as well as technical considerations in planning research. The following was written primarily to indicate to the other authors of these personal accounts of research the sort of thing the editors had in mind for the series.

Hard Spots in Aluminum Castings

When in charge of research for the Aluminum Castings Company, the writer had a hurry call to one of the plants to locate and eliminate the cause of hard spots in automotive castings being supplied to a customer.

These hard spots were chipping the edges of the milling cutters and the failure to get satisfactory castings was disrupting the customer's production schedule so badly that another source of supply would be sought unless the trouble was remedied immediately. The manager, always inclined to look first to the incoming metal for sources of trouble, had already cut a lot of ingots into bushels of chips, looking for hard spots in the ingots themselves, without finding any.

Hasty qualitative analysis showed the hard spots to be high in iron. Hence, the iron melting pots were first looked into. Inquiry established that most of the pots in use were quite old and nearly ready to be discarded. Some had just been discarded, so the scrap pile was examined. Still adhering to the sides of the pots, but ready to drop off at a touch, were some pieces of iron-aluminum alloy, while many scaled spots showed where other pieces had dropped off, doubtless into the ladles of metal that had poured the customer's castings. The alloy chunks were so hard that they wore down an emery wheel almost as much as the wheel wore them. All the old pots were jerked out at once and replaced by new ones, metal from the new pots poured into the irate customer's castings, and the castings rushed to his plant. No hard spots were found and the customer was appeased.

The problem then resolved itself into keeping the pots always in the shape of a new pot as regards scale. The ladle men were instructed not to hit the side of the pot with the ladle and not to dip clear to the bottom. Every noon and night all metal was ladled out of the pots and the sides scraped free from scale with a shovel ground down to fit the contour of the pot. All plant scrap was watched for iron core wires, chills, and any machine shop scrap returned from customers was freed from studs or other pieces of steel.

There was no recurrence of the trouble in that plant. The general superintendent sent samples of embedded hard spots, of the broken milling cutters they had caused, and of the pot scale, with a full statement of the cause and remedy of the difficulty to the other plants of the company and instructed the managers to show the samples to the foremen, melters, ladle men, and inspectors. From that time on everyone not only knew what caused that kind of hard spots, but they avoided them.

The problem itself was a minor one and was more of a detective stunt than a true research problem, though the research point of view was helpful in untangling the causes. The point worthy of comment is that the management utilized the information, bringing it in a dramatic fashion to the attention of those who could use it, instead of pigeon-holing the Research Department's report. It is classed as successful because it led to a permanent improvement.

Silico-Manganese from Low-Grade Domestic Ores

As an example of a project technically satisfactory, but whose results were never put to use because of economic conditions, may be cited work done by the Bureau of Mines from the point of view of war necessities on electric smelting of low-grade manganese ores to show whether, regardless of cost, domestic ores could be used.

Particular interest centered in the low-manganese, high-silicon, high-phosphorus ores. It was established that by smelting with only a little carbon as reducing agent, obtaining but a small metal fall, most of the phosphorus, a little iron, and but very little manganese could be separated, the melt thus purified from phosphorus tapped into another furnace, more reducing agent added, and smelting continued so as to get high manganese recovery, producing a silico-manganese.[1]

At that time steel makers were doubtful, in spite of Hoyt's[2] illuminating study of the subject, whether silico-manganese was a possible substitute for any part of the ferromanganese and ferrosilicon required in steel making. Use in other experimental work[3] of the silico-manganese thus made from the low-grade ore showed it to be satisfactory from all criteria that were applied. In view of later interest in and partial acceptance of silico-manganese for production of clean steel, under certain conditions it seems odd to look back to the days of almost unanimous prejudice against it.

The possibility of silico-manganese production from low-grade ores was a war-time ace in the hole, because, had the submarine campaign not been so combated as to allow use of shipping for importation of high-grade for-

*Director, Battelle Memorial Institute.

eign ores, steel makers might have been forced to use domestic ores, and electric furnaces could have been built and put in service much quicker than a blast furnace. In normal times the price of ferromanganese would by no means allow the extra cost of purifying the low-grade ore from phosphorus, or the competition of electric smelting with blast furnace smelting on high-grade ores. No one would be justified in starting such a research project with the idea of profit-making application of the process in normal times, since the economic situation would forbid.

Ferro-Uranium

Another project, fruitless because of both economic and technical conditions, was that on ferro-uranium. In its work on recovery of radium from carnotite, the Bureau of Mines accumulated a stock of uranium oxide which was a drug on the market, established uses being small.

In the hope of finding some use that would give it greater value, the production of ferro-uranium was worked out[4] and some study[3] made of its behavior in steel, without finding it to do anything that could not be accomplished as well or better by cheaper alloying elements, and finally the stock of oxide was disposed of for other purposes.

Were this project active today, instead of in 1916, it would be interesting to see whether uranium would not resemble its congeners, tungsten and molybdenum, in conferring creep-resistance upon heat-resistant steels. But the creep problem had not then arisen. Since rich pitchblende finds were later made in the Belgian Congo and still later in Canada, the urge for finding useful applications for the uranium obtained as a by-product of domestic radium production has shifted and the economics of the problem now make it one for Canadian interests.

Manganese-Molybdenum Steel

On the other hand, an economic situation may make the application of new research information so advantageous that practical use is promptly made of it. In fact-finding work for the Bureau of Mines, aimed to show the possibilities and limitations in the use of molybdenum as an alloying element in steel, because of its American origin as compared with the foreign origin of some of the alloys for steel, results were obtained[5] with molybdenum in combination with manganese, the latter in amount sufficient to be classed as an alloying element, that compared favorably with those resulting from its use in combination with some more expensive elements.

Gregg[6] states that the properties of these steels were first fully described in the Bureau publications. The logic for their use, of course, impressed many metallurgists and the good properties of the steels became rapidly established, so that they have come into considerable use.

Electric Brass Melting

A more successful Bureau of Mines project, from the point of view of industrial application, resulted from the study of electric brass melting. In 1912, when copper was selling for some 15c per pound and zinc for some 7c, government officials were worrying about conservation of natural resources instead of about over-production. From that time till after 1920, our natural gas resources were considered all but exhausted and those of petroleum in a precarious state, so that substitution of electricity, either hydro-electric or coal-generated, seemed to be decidedly in order from the economic point of view.

The American Chemical Society held a symposium in 1911 on mineral wastes at which Bassett[7] discussed the loss of zinc in melting brass in fuel-fired furnaces, and Parsons[8] pointed out that a suitable electric furnace should minimize the zinc loss. The Bureau took up the problem in 1912, first making a survey[9] of the performance of fuel-fired furnaces and finding that the value of the annual metal loss and crucible cost was in the millions, so that there was an obvious economic need for an efficient electric brass furnace.

Study of different types of electric furnaces for brass melting went on, showing that metal losses could be greatly reduced by electric melting but that some types like the direct arc and stationary indirect arc types would not reduce metal losses, while many other types, including some that were put on the market, were barred from permanent consideration due to low thermal efficiency.

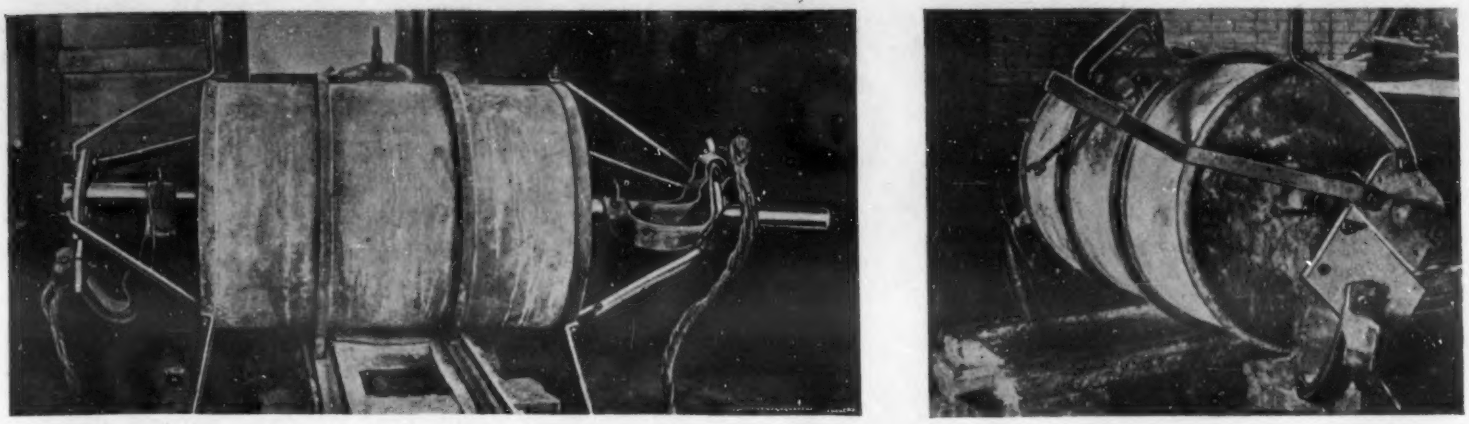
Dr. G. H. Clamer and co-workers were adequately developing the vertical ring and high-frequency type of furnaces and coöperated wholeheartedly in supplying information as to their progress, so the Bureau's work was confined to field observations on these furnaces, and on others that appeared on the market only to disappear because of one failing or another, and to laboratory studies of types not being elsewhere developed. The work was essentially of a fact-finding nature without expectation of producing any new furnace that would dominate the field or any part thereof. Type after type was tested, found to lack suitability, and reported upon, the work that was giving these negative results being consistently supported and encouraged by the Bureau executives, especially by Dr. Parsons, in direct charge of the work.

Many times when the work seemed to be getting nowhere, was the writer cheered by Dr. Parson's hopeful attitude, continuous support, and willingness to supply needed materials and equipment as well as the aid of able assistants.

Had the economic need for electric brass furnaces not justified sticking to the problem, a less far-seeing executive would have stopped the work years before it was finished.

Finally, however, the experimenters hit upon the expedient of rocking an indirect arc furnace to stir the metal so as to avoid the local overheating that caused excessive metal loss in a stationary furnace and to wash the furnace walls with metal so as to absorb stored heat, thus combining high thermal efficiency with a saving of metal and producing a serviceable type of furnace.[10]

It happened that the Detroit Edison Company was interested in anything that would increase its load and the Bureau had thus been closely in touch with Mr. E. L. Crosby of that firm. While the Bureau had no direct means of putting anything it devised into industrial use, it was interested in any arrangement that would bring the furnace into use so the savings it had been trying to make possible could be actually achieved. So, as soon as the small-scale laboratory tests had convinced him that the idea was sound, the writer hopped a train to Detroit and showed the test results to Mr. Crosby. As he too was then equally convinced that the outfit would serve the purpose, Mr. Crosby and the writer spent half an hour with Mr. Alex Dow, President of the Detroit Edison Company, who without hesitation authorized an appropriation for building and testing a commercial-sized furnace in coöperation with the Bureau. Many "bugs" were eliminated from the design through the knowledge and assistance of the Detroit Edison staff and the furnace was thus brought into such shape that a comprehensive series of tests in a Detroit foundry showed it to be a success.



Two Views of the Rocking Furnace (Courtesy United States Bureau of Mines)

Mr. Crosby then left the Detroit Edison Company, with their blessing, as his enterprise was expected to prove a load-builder for the company, financed and formed the Detroit Electric Furnace Company. Thus the handling of the "pilot" stage and the marketing of the furnace were adequately taken care of. Had a less able or energetic group than the Detroit Edison Company and the Detroit Electric Furnace Company been chosen to coöperate with the Bureau, nothing permanent would have been likely to result. Indeed, as soon as the furnace was seen to work, two other furnaces similar in principle, but lacking some of the features that the long study in the laboratory experimental and the pilot furnace development had shown to be essential, were built by others, one of them never getting beyond the building of the first furnace, the other having a total sale of perhaps 50, of which there are probably none in operation today.

Still another group built a rocking furnace, following the Bureau design in some detail, but, lacking the pilot stage experience, never got it to a stage where it could be given an official test for approval and licensing by the Bureau. Later, some analogous designs were brought out by German firms,[11] which have apparently found some use in that country.

The rocking furnace as made by the Detroit Electric Furnace Company had rather rapid adoption, over 500 furnaces having been constructed to date. Of these, about 80 are used for melting cast iron, malleable iron and steel, though the initial development was aimed wholly at brasses and bronzes. One of the writer's staff used the first experimental rocking brass furnace, working on his own time, to melt cast iron for a set of oversize pistons for his car and produced a very nice set of castings. Its commercial use for cast iron was, however, unexpected, and was due to its efficiency in small sizes. This type of furnace was also used to good advantage for experimental melts of steel in later work of the Bureau of Mines,[8] Bureau of Standards,[12] and Battelle Memorial Institute.

The ability to operate efficiently in small sizes brought emphasis, during the development stage, on the marketing of small furnaces for foundry work where flexibility was important, and the small furnaces have continued to be useful during the depression, when production was of too small volume to allow continuous use of large furnaces.

Economic conditions have changed greatly since 1912-1922, in which decade the electric brass furnace development went on. Natural gas and oil did not fade out of the picture as industrial furnace fuels, but now compete even more vigorously than then. On the other hand, the efficiency of production of electric energy from coal has increased so hugely that electric melting is still in about as good a competitive condition on the fuel cost basis as it was then.

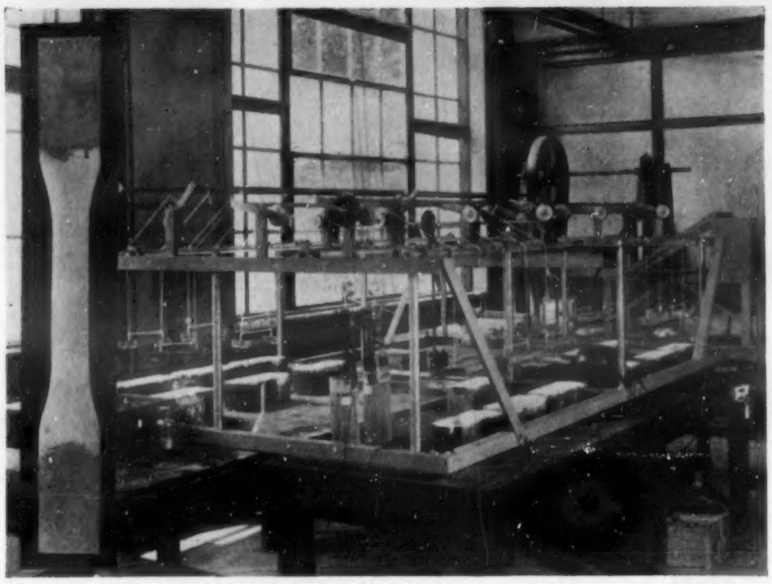
At the average metal prices of 1932, or 1933, there would not have been as much urge to engage in research whose chief aim was to cut down metal losses. The Bureau executives who started and supported the investigation did so at the time when economic conditions were ripe for the speedy adoption of electric brass melting. Having obtained introduction in suitable times, the furnace was able, through auxiliary advantages not expected at the start, to continue to give useful service under economic conditions, which, had they obtained at the inception of the work, would have made it seem hardly worth undertaking. Similar success has crowned the work of Dr. Clamer and his associates on their induction furnaces for brass, those furnaces being now standard in the wrought brass mills for 24-hour service on all but perhaps the alloys highest in copper, while the rocking furnace, due to its ability to change from one alloy to another and to operate conveniently and efficiently on 8-hour operation, has found the widest use in sand casting shops.

Both developments had the benefit of long-term executive support, were begun at a propitious time from the economic point of view, and the marketing angles were properly handled.

Aluminum-Coated Duralumin

About the time the writer went to the Bureau of Standards, the Navy discovered intercrystalline corrosion and embrittlement in the duralumin wing covering of its airplanes and the Bureau was asked to study the problem. Mr. Rawdon did some remarkably fine work[13] in developing that unusual thing, an accelerated laboratory corrosion test that produced the same type of corrosion as occurred in practice, and, with this and extensive exposure tests as tools, in locating the causes of the trouble. Since complete removal of the difficulties by control of composition, cold water quenching, prevention of access of chlorides, etc., was not always feasible, the writer looked around for other methods of combating the difficulty.

Knowing from his own experiences in camp cooking that aluminum cooking utensils of pure or manganese-bearing aluminum do not become embrittled, even after long periods of use and contact with the salt used in cooking, it seemed clear that a thin coating of pure aluminum would protect the underlying duralumin, because "save the surface, you save all." Since it is not commercially feasible to electroplate an aluminum coating, use of metal spray or of some way of making a duplex sheet with a thin aluminum surface was indicated.



At Left: Tensile Bar Sprayed with Aluminum only over the reduced section of the bar. At Right: Repeated-immersion Apparatus used in Laboratory Testing of Duralumin Specimens. (Courtesy of U. S. Bureau of Standards.)

After discussing this work with Dr. Jeffries and receiving his assurance that the idea appeared to have merit, the writer got Mr. Saeger to metal spray a series of duralumin test specimens with aluminum and Mr. Rawdon to try them out in the accelerated corrosion test, where they stood up so well that more specimens were coated and exposed in the series being studied for the Navy.

Meanwhile the Aluminum Company of America had taken up, as they were much better fitted to do than the Bureau, the problem of making duplex ingots and rolling them to sheet, this finally resulting in the well-known Alclad duralumin now widely used in the aircraft industry. Aluminum coating by this method is, of course, cheaper and more satisfactory than by metal spray. At the time the Aluminum Company made its first announcement of Alclad,[14] the Bureau had already completed a one-year exposure test on the metal-sprayed aluminum-coated duralumin. While the Bureau deserves no credit for the development of Alclad itself, the Aluminum Company has always been most meticulous in giving credit to the Bureau for showing, by its study of metal-sprayed material, the value of the aluminum coating, so the Bureau can at least claim to be a grand-uncle of Alclad and to feel pride in its success.

From the point of view of marketing a product to meet an industrial need, the fact-finding studies of the Bureau, brought to the attention of executives like those of the Aluminum Company, quick to see the utility of a research idea, diligent in carrying it through the pilot stage vicissitudes, and themselves having and utilizing immediate facilities for marketing their product, were as effective as though there had been some more direct means for the Bureau to put a new development into production.

Rubber-Bonded Cores

A good idea brought out by research may, however, not always be promptly adopted, as is evidenced by one project at the Bureau of Standards with which the writer was in touch, but for which the credit is due entirely to Mr. Saeger. Wishing to have a reproducible base-line for testing of core sand that did not involve any question of possible variations in core oven temperature in the baking of the cores, Mr. Saeger tried rubber cement as a core bond, air drying the cores. No one would have thought such a bond would be useful in an actual core for the core would not be expected to hold its shape when the metal hit it and would be expected to "blow."

But Mr. Saeger's natural curiosity led him to try such cores in a casting, when he found[15] that they did not blow, that they hold their shape, and, most surprising of all, that after the core had done its work, the bond disintegrated, leaving only loose sand that could be poured out cleanly.

Surfaces thus cored in castings of lead, tin, zinc, aluminum, brass, bronze, cast iron, and, in some cases, even in steel, were very good. The avoidance of the cost of removal of ordinary cores that burn into the metal, especially in cases where adhering sand that later loosens in service may wreak havoc with a machine, would make it seem that it might be economical to use such cores in a good many cases. One rubber company did quite a bit of work with the process, but foundry work was not down their alley and it is doubtful if adequate coöperation of foundrymen was utilized.

Some few foundrymen have made good use[16] of rubber as a dip, while others who tried it as a binder had difficulties with sticking in the core boxes and felt that the rubber polymers that gave best results were too expensive. The writer believes that were the project again taken up under the right commercial auspices, the remaining bugs worked out and the process pushed at the right time in relation to the rubber market, a rubber binder might still work out to be a real success.

Prevention of Embrittlement in Galvanized Structural Steel

A good example of effective organization and research on a "joint-interest" problem, is the work on embrittlement in galvanized structural steel, sponsored at Battelle Memorial Institute by the Utilities Research Commission and the American Society for Testing Materials and carried out by Mr. Epstein[17] and co-workers.

A shipment of galvanized transmission tower steel was being unloaded from a railway car when a piece fell to the ground and broke off, in brittle fashion, through the rivet holes. In another case, a heavy, punched angle broke in brittle fashion during erection of a tower.

Since this latter angle, at least, met purchase specifications, yet acted in a brittle fashion, it was obvious that some factor was not under proper control. Since a failure of a transmission tower carrying live wires at a highway crossing, for example, might be disastrous, the finding of this brittle angle made from ductile steel, was disturbing to utility engineers, who sought to find out from the steel makers as a group what caused the trouble and how to prevent it. The steel makers could make no sufficiently convincing nor unanimous reply, though several did have, as it later turned out, a pretty fair idea of where the trouble might be looked for.

The steel makers, too, were disturbed, not only because they wanted to keep their utility customers out of trouble, but also because such failures, if allowed to go unexplained, and if more were allowed to occur, would give all structural steel an undeserved black eye. The fabricators and galvanizers were also concerned because galvanizing might have been a convenient scape-goat to lay the troubles upon, were there no definite experimental proof to the contrary, which they could not then furnish.

The problem was first attacked under the sponsorship of the Utilities Research Commission, though from quite the same point of view as was brought to bear in the later work sponsored by the A.S.T.M.

But since so many producer and consumer interests were concerned, it was concluded, after the usual period of discussion common to joint projects (for the completion of which the Utilities Research Commission did not care to wait before getting work started), that the project should thenceforth be sponsored by a special A.S.T.M.

committee on which all the interests were represented. Since this committee was too large to be wieldy, a small Steering Committee, fully representative of all the interests concerned, was set up to outline the program, study the monthly reports and meet with the investigators for frequent conferences.

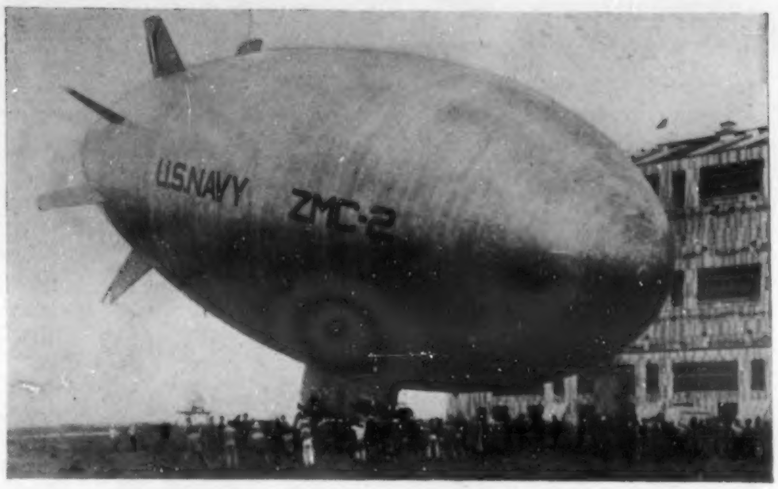
The personnel of this Steering Committee was so representative and so broadminded that when they came to an agreement, it was a foregone conclusion that it would be one in which the main committee and the society as a whole would agree. Since the experimental work was put in the hands of an impartial, independent research laboratory, the experimental results were assured of being free from any possibility of ax-grinding bias.

It was desired that the remedy for the trouble, if a remedy were found, be put immediately into practice and this could readily be accomplished by the preparation for adoption by the society of an acceptable "recommended practice" and methods of test that could be incorporated in the purchase orders of the utility interests for steel. But this could only be accepted by all if it were firmly founded on fact and the facts proven beyond cavil. Thus, if a really good job were done, the mechanism for "marketing" the results, i.e., putting them into practice, was at hand.

The technical phases of the work brought out clearly that the trouble was due to local brittleness about the rivet hole, induced by punching very thick angles, and very thick ones only, resulting in an angle of inherently ductile steel making an inherently brittle fabricated part. The simple and not expensive expedient of drilling or subpunching and reaming the heavy sections was found sufficient to remove the undesired conditions, and the lighter sections, even though punched, were found to present no difficulties. While extremely extensive work was required to establish this fact and answer many pertinent auxiliary problems, the simple explanation and simple means of prevention were finally so clearly established that the facts were accepted by all concerned, the code of recommended practice drawn up and adopted and the job, including the "marketing," completed. That the technical phases were considered successful is evidenced by the fact that Mr. Epstein received the Dudley Medal for the outstanding A.S.T.M. paper of 1932 representing original research.

In the writer's opinion, a joint problem of this sort normally contains more troublesome factors of psychology than it does of technology, and the success of the project was due to the wisdom of the Sponsors in arranging for effective executive control through the small, strong Steering Committee.

One could cite other projects from past and present research work of varying degrees of success, whose examination would consistently reveal that when a technically reasonable research project is taken up under economic conditions that are favorable for the utilization of the research product, be it merely knowledge or some specific new product, one may look forward to a satisfactory technical solution with considerable hope if the research men are given time, facilities and encouragement. But whether that solution will be put into practice and return dividends depends far more often on the will of the executive to push the matter through the pilot stage and the final marketing stage than it does on the inability of the research men to give him something worth marketing.



Metalclad Airship (Official Photograph U. S. Navy)

Distorted Structure at Surface Inside of Punched Hole in an 8x8x1 inch Angle. Local Brittleness is due to this Distorted and Hardened Layer.

References

[1]H. W. Gillett & C. E. Williams. Electric Smelting of Domestic Manganese Ores. *War Minerals Investigations Series, Bureau of Mines,* No. 10, Dec. 1918, 48 pages.

See also Chapter 10, pages 151-186, Bulletin 173, *Bureau of Mines,* 1920.

[2]L. Hoyt. Use of Manganese Alloys in Open Hearth Practice. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 62, 1920, pages 113-125.

[3]H. W. Gillett & E. L. Mack. Experimental Production of Alloy Steel. *Bulletin* 199, *Bureau of Mines,* 1922, page 30.

[4]H. W. Gillett & E. L. Mack. Preparation of Ferro-Uranium. *Technologic Paper* 177, *Bureau of Mines,* 1917, 46 pages.

[5]H. W. Gillett & E. L. Mack. Molybdenum, Cerium, and Related Alloy Steels. Chemical Catalog Company, 1925.

[6]J. L. Gregg. Alloys of Iron and Molybdenum. McGraw-Hill Book Co., 1932, page 390.

[7]W. H. Bassett. Zinc Losses. *Journal of Industrial & Engineering Chemistry,* Vol. 4, 1912, page 164.

[8]C. L. Parsons. Notes on Mineral Wastes. *Bureau of Mines, Bulletin* 43, 1912.

[9]H. W. Gillett. Brass Furnace Practice in the United States. *Bureau of Mines, Bulletin* 73, 1914.

[10]H. W. Gillett & A. E. Rhoads. Melting Brass in a Rocking Electric Furnace. *Bulletin* 171, *Bureau of Mines,* 1918, 131 pages.

H. W. Gillett & E. L. Mack. Electric Brass Furnace Practice. *Bulletin* 202, *Bureau of Mines,* 1922, 334 pages.

H. W. Gillett & E. L. Mack. Present Tendencies in Electric Brass Furnace Practice. *Reports of Investigations, Bureau of Mines, Serial* No. 2597, April 1924, 10 pages.

[11]E. F. Russ. Die Elektrischen Schmelzofen für Metalle. *Metall und Erz,* Vol. 19, 1922, page 333; *Stahl und Eisen,* Vol. 43, 1923, page 116.

T. Metzger. Der Electro-ofen in der Metallindustrie. *Zeitschrift Verein deutscher Ingenieure,* Vol. 70, 1926, page 349.

[12]L. Jordan. Bonding Magnesite Linings for Steel Melting Furnaces Without Use of Iron Oxide. *Metals & Alloys,* Vol. 3, Jan. 1932, pages 22-24.

[13]H. S. Rawdon. Correlation of Laboratory Corrosion Tests with Service: Weather Exposure Tests of Sheet Duralumin. *Transactions American Institute of Mining & Metallurgical Engineers, Institute of Metals Division,* 1929, pages 220-241.

Corrosion Embrittlement of Duralumin. *Technical Notes* Nos. 282 (1928), 283, 284, 285, 304, 305 (1929), *National Advisory Committee for Aeronautics.*

[14]E. H. Dix, Jr. Alclad, A New Corrosion-Resistant Aluminum Product. *Technical Note* No. 259, 1927 *National Advisory Committee for Aeronautics; Mining & Metallurgy,* Vol. 8, 1927, page 395.

[15]C. M. Saeger. Rubber Binders for Foundry Cores. *Bureau of Standards Letter Circular* 252, Sept. 4, 1928.

[16]H. M. St. John. Use of a Rubber Solution for Core-Dipping. *Metals & Alloys,* Vol. 1, July 1930, page 588.

[17]S. Epstein. A Study of the Embrittlement of Hot-Galvanized Structural Steel. *Proceedings American Society for Testing Materials,* Vol. 32, part 2, 1932, pages 293, 379.

Refractory Concrete

Refractory Concrete Cast in Place for Upper Portion of Annealing Pit Walls.

By R. T. Giles*

Early History

REFRACTORY concrete is relatively new. Perhaps the first refractory concrete in this country was used in Philadelphia in 1925 for patching furnace linings and ash pits. The first special shapes of refractory concrete of which the writer has knowledge were made in 1926. Also in 1926 a considerable amount of experimental work was done with refractory concrete for making semi-permanent molds in foundries. Since that time the use of refractory concrete has steadily expanded until at present it is giving economical and satisfactory service in a number of industries and is gradually extending its scope to include additional industrial uses in the various heat-treating fields.

Unsuccessful Attempts to Use Portland Cement

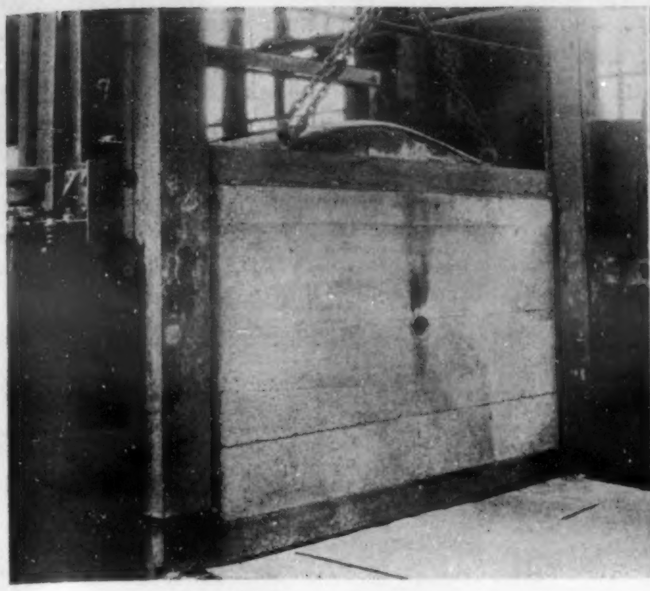
For making refractory concrete it is necessary to have a binder which will give the required cold strength to hold the lining in place until it has developed a ceramic bond under operating temperatures. It was natural that many attempts were made to use portland cement as a binder for refractory aggregates. Some degree of success was obtained in low temperatures (1000° F. and under) but the constitution of portland cement did not lend itself to successful results in temperatures above 1000° and as high as 2000° or 2500° F. Above these temperatures it acted as a flux when used with an acid aggregate. With the modern development of portland cement in which the early strength is developed more rapidly its suitability has been reduced until at present some companies which formerly used it in temperatures as high as 1000° F. now limit its use in maximum temperatures of only 500° F. The unsuccessful attempts to use portland cement as a refractory binder developed in refractory users' minds distinct prejudice against the use of all hydraulic cements. Many refractory users still think the hydraulic property of portland cement makes its use unsatisfactory, but it has been rather definitely proven that the difficulty is due to its chemical compounds.

Introduction of High Alumina Cement

When Lumnite, a high alumina cement, was introduced in 1924, it was used primarily for high-early-strength concrete. Early experiments indicated the possibilities of its successful use in the refractory concrete field as well, but the prejudice against hydraulic cements in refractories considerably delayed its progress. As the number of successful refractory installations grew, however, it became apparent that the difference in chemical com-

*The Atlas Lumnite Cement Company.

Monolithic Refractory Concrete Lining in 12' Diameter Hot Metal Cover After One Year Service. This Lining in Practically Same Condition at End of Two Years' Service.



Door Lining of Refractory Concrete After 14 Months' Service.

Annealing furnace door lined with Lumnite and Sil-o-cel C-3. This lining has had 3 years of service.

Cast in Place Car Tops of Refractory Concrete for Annealing Furnace.

position between a high alumina cement and portland cement gave the former some very definite advantages for refractory purposes which portland cement lacked. The high alumina cement, made from bauxite and limestone, results in calcium aluminate, whereas portland cement, made from silica and limestone, results in calcium silicate. Also, portland cement is clinkered during burning, whereas a high alumina cement is completely fused. As these differences have become known and as test data and service records have become available from an increasing number of successful installations, there has been a distinct acceleration in the employment of refractory concrete made with the high alumina cements and the trend seems to be established toward even more widespread use.

Function of Lumnite in Refractory Concrete

The user of a high alumina cement in refractories should appreciate that it is not primarily a refractory material. It is and should be used only as a binder of refractory materials to provide the cold or prefired strength. The refractoriness of the shapes or lining of refractory concrete will depend almost wholly on the quality and suitability of the aggregates for the particular exposure. If a fire brick will not give satisfactory length of life at a temperature of 2700° F., crushing the brick as aggregate to be mixed with Lumnite will not make the resulting refractory concrete give satisfactory length of service at this temperature.

Development of Prefired and Fired Strength

Within 24 hours after the cement, aggregate and water have been mixed, the refractory concrete will have developed most of its cold (hydraulic) strength, the same as if regular construction concrete were being made. More hydraulic strength is necessary for low temperatures than for the higher temperatures, which means that mixes for the lower temperatures require a higher percentage of cement than mixes for the higher temperature. This rather unusual circumstance is due to the longer time required to develop fired strength in the lining under operating conditions when exposed to low temperatures. It will be seen from this that while the lining is placed as refractory concrete, the operating temperatures gradually change it to a fired ceramic shape or lining.

Nature of Aggregate to be Used

Lumnite when used in refractories is very nearly neutral and for that reason is used with acid, basic or neutral refractories to make the type of lining suitable for the particular exposure. Having selected the proper aggregate to be used with the cement for making refractory concrete, attention should be directed to the proportions, the grading of the aggregate, mixing and placing of the concrete and curing before firing.

Proportions

The following table is a good basis for determining the best proportion of cement and aggregate for the particular installation:

1 Bag Lumnite = 94 Lbs. or 1 Cu. Ft.

	Acid Refractories	
Cement	*Aggregate*	*Temperature Up To*
1 bag	3½ cu. ft.	2100° F.
1 "	6 " "	2400° F.
1 "	8 " "	2700° F.
	Basic Refractories	
Cement	*Aggregate*	*Temperature Up To*
1 bag	4 cu. ft.	2500° F.
1 "	7 " "	2750° F.
1 "	10 " "	3000° F.
	Neutral Refractories	
Cement	*Aggregate*	*Temperature Up To*
1 bag	4 cu. ft.	2750° F.
1 "	8 " "	3000° F.

Grading of Aggregate

The aggregate should be well graded from the maximum size particle, usually ¾" or 1", with all the intermediate sizes down to and including 15% passing the 100 mesh sieve. It will be noted that 15% passing a 100 mesh sieve is somewhat different from gradations recommended for regular construction concrete work. The need of the fine dust is twofold: First, most refractory aggregates, especially those made from old fire brick or pottery saggers, are extremely brash and produce a harsh-working concrete unless ample fines are incorporated in the mix. Second, this fine dust combines with the cement at lower temperatures, thereby promoting fired strength much sooner than when no fine dust is used in the mix. It is sometimes difficult to crush the aggregate to produce the necessary fines. This may be compensated for by adding one-half cubic foot of plastic fire clay to each one-bag batch.

Mixing

Mixing should be sufficient to mix intimately all the fine particles of the cement and aggregate dust. When mixing by hand, dry mixing until a uniform color is obtained will assure this. After dry mixing to a uniform

color sufficient cool water (not over 80° F.) should be added to produce a plastic, soft, sticky mix. If the aggregate contains sufficient fine dust the mix will be plastic, easily placed by spading without ramming, and will not release free water. Refractory concrete which requires a great deal of ramming, as is common when placing old-type plastic refractories, is either deficient in fine dust or mixing water or both.

Placing

Placing of the concrete should be in such a way as to eliminate planes of weakness. For example, if a door is being lined which requires three batches, the first batch should be placed for one-third of the length and the entire depth of the door; the second batch for the next third of the length and the entire depth of the door; the third batch for the last third and the entire depth of the door. If the first batch is distributed over the length of the door for one-third of the depth, there may develop between the first and second batches a plane of weakness which may weaken the lining when it has been in operation for some time. In all cases the concrete should be spaded to densify and consolidate it.

Curing and Drying

At normal temperatures (70° to 80° F.) no curing with water is necessary when a highly absorptive aggregate such as fire brick or pottery saggers is used. For the less absorptive aggregates such as chrome ore or magnesite, and at temperatures above 80° F., better surfaces will be obtained if sprinkled with water about 10 hours after placing. Relatively thin sections are often put into service at the end of 24 hours. Thicker sections may require a day or so of air drying. They should then be brought up to operating temperatures gradually. In the case of thick door linings which are suddenly exposed to maximum operating temperatures, several days of air drying may be necessary.

Uses of Refractory Concrete

Refractory concrete has been used in:

Coke plants for lining doors and standpipes; patching jambs, grouting roofs, patching floors and jambs under doors and for making special shapes.

Steel mills for soaking pit wall repairs; billet heating doors and wall repairs; merchant mill doors; plate mill doors; sheet mill doors, arches, walls and bottoms; rod mill doors, walls and bottoms.

Oil refineries for oil still furnaces and reaction chambers.

Annealing furnaces for walls, doors, bottoms and car tops.

Forge furnaces for arches, walls, doors and bottoms.

Malleable foundries for annealing furnace doors and car tops.

Tunnel kilns for car tops.

Refractory Mortars

Refractory mortars are used for patching, being placed by hand or "shot" with a cement gun. The life of furnace and boiler walls can be increased considerably by frequent shooting.

Insulating Concrete

Lumnite is also used as a binder for insulating aggregates for making insulating concrete. In addition to the commercial insulating aggregates it has been used with granulated blast furnace slag where the temperature does not exceed 1000° F. and with Haydite a prepared porous clay aggregate in temperature up to 2000° F.

Cost of Refractory Concrete

The cost of refractory concrete is of considerable interest. Many plants have available old fire brick which are of no value to them as they cannot be used. By crushing these old brick a very suitable aggregate for many installations is produced at a nominal cost. Other plants are located close to pottery plants where they can obtain old pottery saggers for aggregate at a nominal cost. When a cheap aggregate such as the above is available, the cost of refractory concrete is often not more than half that of fire brick and sometimes only one third.

Users who do not have either the cheap aggregate available or the equipment to prepare the aggregate can purchase from a number of refractory firms a castable refractory ready to use with the addition of water. These prepared materials have been extensively used in numerous industries with very satisfactory results.

A. I. M. E. Meeting

The 143rd meeting of the American Institute of Mining and Metallurgical Engineers will take place February 19-22, 1934, in the Engineering Societies Building, 29 West 39th Street, New York City. The sessions of the Iron and Steel Division extend from Monday afternoon until Thursday morning while the Institute of Metals Division runs from Tuesday afternoon until Thursday afternoon.

The meeting of the Editorial Advisory Board of METALS & ALLOYS will be held on Wednesday, February 21st in Room 1, Engineers' Club.

"For Pioneering in Industrial Research"

"For pioneering in industrial research," the General Electric Company was presented on Thursday, February 1, with a gold medal by the American Institute of the City of New York. The American Institute, which was founded more than one hundred years ago, includes among its objectives the recognition of achievements in science which have profoundly influenced human affairs. The Council on Awards of the Institute decided that the establishment and maintenance by the General Electric Company of its large laboratory for pure research has been of lasting benefit to human progress and industry. This laboratory, which was created in 1900, when Dr. Willis R. Whitney went to Schenectady from the Massachusetts Institute of Technology to assume the position of research director for the company, has been the scene of scientific discoveries which have greatly expanded existing industries and have created in several notable instances large new industries.

New Research Project

A new research project at Battelle Memorial Institute, 505 King Avenue, Columbus, Ohio, has been announced by the director, Dr. H. W. Gillett. This work is being done for the S. S. White Dental Manufacturing Company of Philadelphia, Pa., under the Institute's sponsored research plan. Starting immediately, this investigation will be in charge of Dr. O. E. Harder, assistant director of the Institute and Mr. William A. Welcker, research engineer.

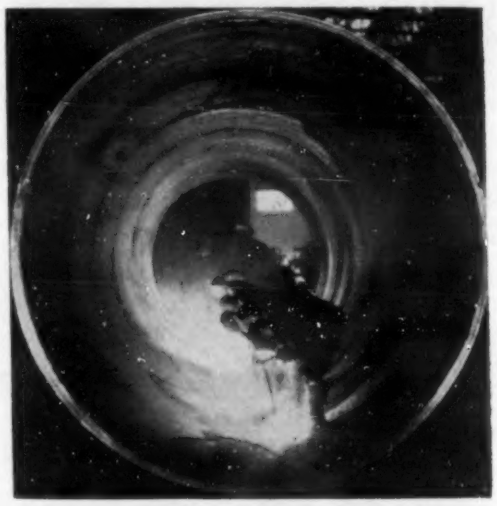
Steel Code Investigators Appointed

The Board of Directors of the American Iron & Steel Institute announces the appointment of Alexander Baxter and George Satterthwaite as special investigators, as part of the program of the Code Authority for enforcement of the provisions of the Steel Code. Baxter formerly was a partner of a well known firm of certified public accountants and Satterthwaite was an executive of a prominent independent steel company. In announcing this step to the members of the Code, W. S. Tower, executive secretary, said that the duty of the investigators "shall be to assist the Administrative Committee in seeing that the members of the Code perform their obligations thereunder, including the investigation of all alleged violations of the provisions of the Code which may be reported." In the official notice, members of the Code are urged to give full coöperation in the enforcement effort, and they are reminded that it is their duty to report promptly any facts coming within their knowledge respecting Code violation.

Low Temperature Impact Tests of Medium Manganese Steel Plate*

H. W. Hiemke and W. C. Schulte

The notch toughness of common plate stock, such as is used in the manufacture of pressure vessels, has not been described in the literature in so far as the effects of low temperatures are concerned. This paper gives the results of such tests over the range from +100° to −50° C. and covers plain carbon steel and the low alloy steels of the silico-manganese and Cromansil types in heavy sections. The sudden drop in impact values at around room temperature is recorded while one steel is shown to retain its high resistance at surprisingly low temperatures. Obviously if one wished to make structures out of heavy walled stock which are to operate at such low temperatures, this information would be of great value.



THE ability of steel to deform plastically before rupture is one of the main reasons for its popularity as a load carrying material. We say that steel is tough because it can deform and absorb energy imposed on it by sudden overloads without failure. There are some conditions of service, however, in which steel fails to exhibit its usual toughness. Failure takes place by cleavage without appreciable deformation, giving the fracture a crystalline appearance, even though a tensile test of the same material shows good ductility.

Such anomalous behavior in a ductile material is encountered when the mechanism of slip is opposed by stress concentrations retarding the reduction of area. Heavy sections, such as gun barrels and railroad rails, are prone to fracture by cleavage failure. Notched sections oppose the normal reduction of area accompanying slip, and are, therefore, susceptible to non-ductile fractures. Very rapid applications of load may also produce brittle fractures.

In order to study the effect of stress concentrations and the problem of plastic versus cleavage fracture, the notched bar impact test has been devised. Its value in selecting engineering materials lies in its ability to evaluate the behavior of steel under the special conditions mentioned above; namely, in notches, in heavy sections, and under impact loading. It supplements the ordinary tension tests, supplying information on toughness which the tension test, neither static nor dynamic, cannot furnish.

Systematic studies[1] of the impact resistance of carbon steels have revealed that certain definite laws govern the rupture, and consequently the notch toughness of impact specimens.

1. It has been shown that steel exhibits a plastic failure in the notched bar test until some critical velocity of impact is exceeded. Above this critical velocity the steel ruptures by means of a cleavage fracture. The transition from plastic to cleavage fracture is quite sharp in the case of C steels, whereas in alloy steels it is more gradual. In the transition range it is possible to obtain impact values of high order, or low order, depending on the fracture. The general shape of the impact versus velocity curve is shown in Fig. 1.

2. The width of the test specimen influences the critical velocity, which, in turn, influences the type of fracture.[1] Normally, it should be expected that twice as much energy would be required to rupture a bar twice as wide as a standard specimen, but it has been found that the critical velocity is lowered by widening the specimen. In case the lowering is sufficient to change the type of fracture from plastic to cleavage fracture, the energy consumed in breaking the wider bar may be less than it is for the narrow one. This relation is indicated by Fig. 2.

*Presented in partial fulfillment of the degree of Master of Science in Metallurgy, University of Wisconsin, June, 1933.

[1]Moser. *Transactions of American Society for Steel Treating*, Vol. 7, 1925, page 297.

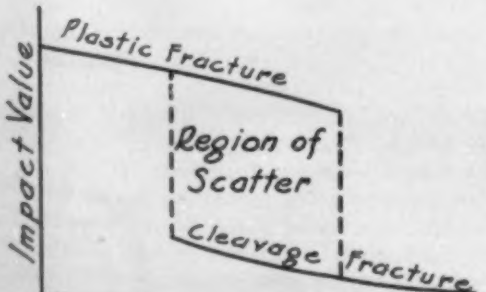


Fig. 1. Schematic Sketch Showing Effect of Impact Velocity.

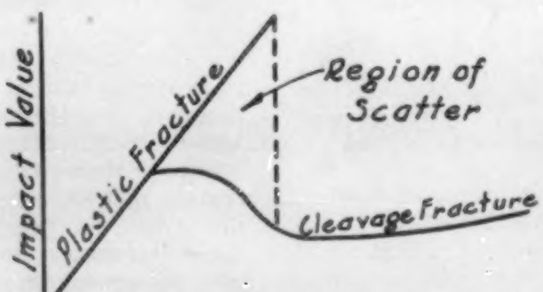


Fig. 2. Effect of Width of Test Specimen (Mailänder. *Krupp sche Monatshefte*, Feb. 1924.)

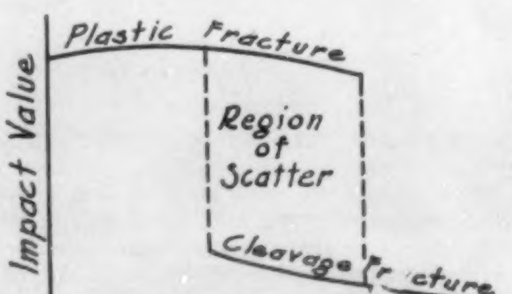


Fig. 3. Effect of Test Temperature (Mailänder *Krupp'sche Monatshefte*, Feb. 1924.)

3. Temperature also influences the results of the impact test. It is quite closely related to the influence of velocity, for at low temperatures, lower critical velocities obtain. Since the velocity of impact is kept constant in the ordinary Charpy test, a temperature is usually reached at which the standard velocity (17.39 ft./sec.) becomes the critical velocity. At that temperature, cleavage fractures are possible, and at lower temperatures cleavage fractures will be the rule. The general form of the impact-temperature curve is shown in Fig. 3.

Most steels behave in the manner indicated by the curve, the region of scatter (critical temperature), occurring somewhere in the range —50° to +100° C. Notable exceptions to this rule are 18% Cr-8% Ni stainless steel, and 3% Ni steel, both of which exhibit ductile fractures (and high impact values) at temperatures below —50° C.

The sudden change of notch-toughness values just below room temperature gives the investigation of this property a practical aspect. Engineering equipment and structures are often used at temperatures down to —40° C., so that the determination of low temperature impact values has a definite design value.

EXPERIMENTAL PROCEDURE

In the present research, we have determined the notch toughness of several grades of Cromansil steel over a range of temperature. This steel is a relatively new material in the low alloy field, containing approximately 1.25% Mn, 0.75% Si, and 0.50% Cr. To study the effect of the various elements making up the Cromansil composition, we have included a group of steels of simpler alloy content. Complete chemical analysis of the steel tested are given in Table I.

Table I. Chemical Composition of Steels Used

Steel	C.	Mn.	Si.	Cr.	P.	S.	Thickness of Stock
A	.25	.49	.014	—	.018	.026	2½"
B	.25	1.24	.06	—	.014	.019	2¾"
D	.26	1.32	.44	—	.011	.022	1½"
E	.20	1.05	.67	.42	.025	.023	2½"
F	.23	1.21	.68	.45	.037	.026	½"
G	.092	1.31	.91	.45	.017	.013	1"Ø

Especial care has been taken in selecting the steels for this work. As far as practicable, we have chosen steels ("A," "B," "D," and "E") which differ progressively by but one element. They are all commercial steels, made and rolled by the same steel mill, and are heavy plate stock of approximately the same thickness. Steel "F" is similar to "E" excepting in plate thickness. Steel "G" is a low C grade of Cromansil steel, in the form of one inch round rods.

Since most of the material was in the form of heavy plate stock, only the simplest heat-treatments were used: namely, furnace annealing, and normalizing. In order that the heat treatments might be comparative for all grades of steel, the critical temperatures of each steel were determined by a differential heating method. The annealing treatment was carried out by heating to a temperature 50° F. above the Ac_3 point, soaking for 2½ hours, and furnace cooling. In order to normalize the small pieces (2½"x2½"x8") required for our tests, the specimens were packed in granulated fire brick, in a box with an open bottom, so that cooling could take place only from the plate faces. In this way, cooling rates more nearly approaching the normalizing of heavy plate stock were attained. Thermocouples were welded to each block during the normalizing treatment and the rate of cooling from Ar_3 to Ar_1 was measured. The values thus obtained are reproduced in Table II.

Table II. Critical Temperatures and Heat-treating Data

	Critical Temps.		Annealing			Normalizing		
Steel	Ac_1 °F.	Ac_3 °F.	Temp. °F.	Time hrs.	Rate of Cooling °F./min.	Temp. °F.	Time hrs.	Rate of Cooling °F./min.
A	1360	1545	1595	2½	5	1620	2	27
B	1335	1520	1570	2½	5	1600	2	35
D	1345	1540	1590	2½	5	1625	1½	65
E	1395	1620	1675	2½	5	1700	2	37
F	1385	1615	1670	2	5	1695	1	176
G	1375	1615	1670	2	5	1695	1½	150

Micrographs of each steel in the 2 different states of heat treatment were made and are shown in Figs. 6 to 17. All of the plate stocks in the annealed state are coarse grained and show ferrite banding; however, the grain size of the "D" steel is finer than the other steels. Normalizing refines the grains of steels "A," "D," "E," and "G" and destroys the ferrite banding. Normalizing has also destroyed the ferrite banding in the "B" and "F" steels, but has coarsened the grains resulting in a ferrite network structure. This is often characteristic of Mn steels. Steel "G" in the annealed state is of medium grain size and is free of ferrite banding. Normalizing has refined the grains.

All the specimens were laid out so that the direction of rolling of the stock was parallel to the length of the specimen. As the plates were quite thick in most cases, the position of the specimens was controlled in relation to the cross section; all of the main series of tests were made on specimens taken from the center of the cross section. As an added precaution, the notch was made on the side of the specimen nearest the plate face. Fig. 4 shows how the specimens were laid out.

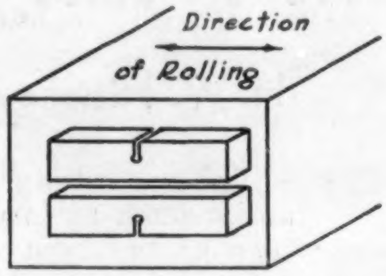


Fig. 4. Layout of Specimens.

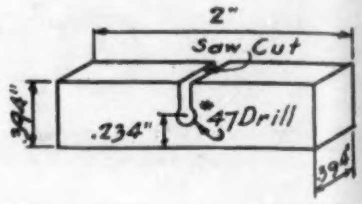


Fig. 5. Specimen Dimensions.

A short series of tests was also made to find out how much effect direction of rolling, and position in the block, have on the toughness. These specimens were tested at —20° C.

The specimens were made with a standard Charpy keyhole notch (Fig. 5). They had a surface ground finish, and were drilled and sawed in special jigs to insure correct positioning of the notch. This position was very important in our testing procedure, as will be described later.

The original program of tests included temperatures of 100°, 50°, 20°, 0°, -20°, -30°, -40°, and -50° C. Later tests were made at +10° C. on steels where extra specimens were available. Two specimens of each steel and each heat-treatment were broken at each temperature. In order to cool the specimens to the temperatures below atmospheric, an acetone bath in an ordinary Pyrex beaker lagged with cotton was used. Solid CO_2 was added in small quantities sufficient to maintain the desired temperature. A calibrated pentane thermometer was used to measure the temperatures. By using a beaker, all the specimens that were to be tested at one temperature could be cooled at one time. The rate of heating of the specimen after removal from the bath was measured at each temperature by means of a dummy specimen, drilled to receive the thermometer bulb. To allow for this heating effect, the bath was undercooled by the necessary amount so that the tests were made at the temperatures recorded. In order to be sure that the specimens were at the bath temperature, they were held at temperature for at least 20 minutes before testing.

In order to avoid the use of a positioning jig for placing the specimens in the machine, we made use of the fact that the notch is always a definite distance from one end of the specimen. By inserting a gage between this end and the vertical wall of the specimen ledge, the notch was always exactly centered.

The results of the Charpy tests are tabulated in Table III.

After the specimens were broken, they were arranged in the respective temperature groups, and photographed. These pictures (Fig. 18) illustrate the change in notched toughness from 100° to -50° C.

Hardness Readings

As a matter of record, the Rockwell "B" and Brinell hardness numbers of the steels used in this investigation are recorded in Table IV. Rockwell "B" readings were also made on the broken Charpy bars to determine the effect, if any, of the various test temperatures. The hardness of all of the specimens of a series were found to be within 2 points of the values listed in the table.

Discussion of Results

The general result of decreasing temperature on the toughness of steel is well illustrated by the photograph of the entire group of test specimens. At 100° C., all the steels have high Charpy values, and the specimens (save two) do not break into 2 pieces. As the temperature is progressively lowered, more and more of the specimens break off squarely.

Fig. 18 shows the fractures of specimens "A" and "G," illustrating how the plastic deformation of the metal decreases with lower test temperature. There is a good correlation between the notch toughness and the deformation at the break, low impact values being associated with small deformations.

There is a temperature range for each steel, excepting steel "D," where sudden fall of the notch toughness takes place as the fracture changes from a plastic to a cleavage fracture. For most steels, this range is between 20° and 0° C. The "D" steel exhibits a gradual reduction of the toughness, in both the nor-

Microstructures of steels at 100 diameters

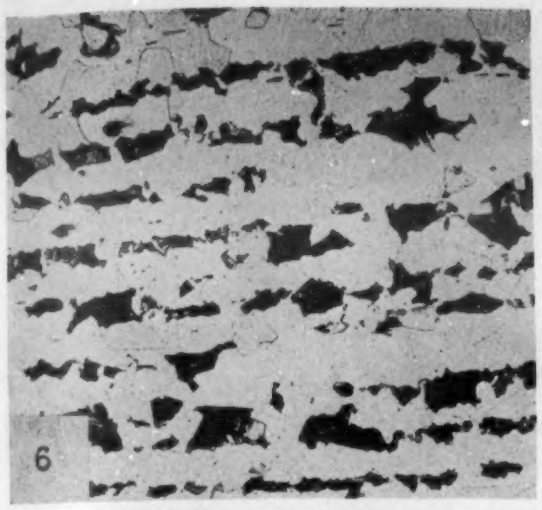


Fig. 6. Steel A, heated at 1595° F., 2½ hours, furnace cooled.

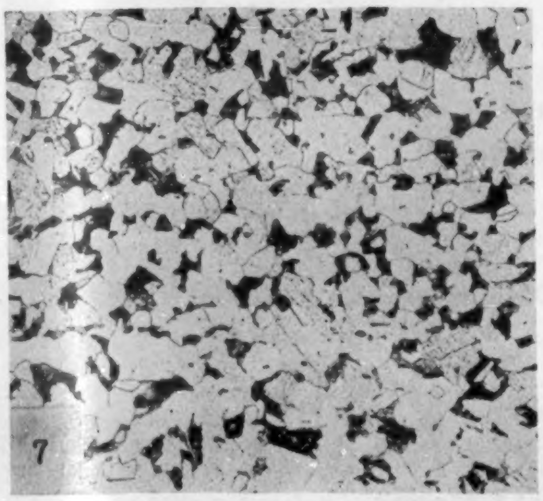


Fig. 7. Steel A, heated at 1620° F., 2 hours, air cooled.

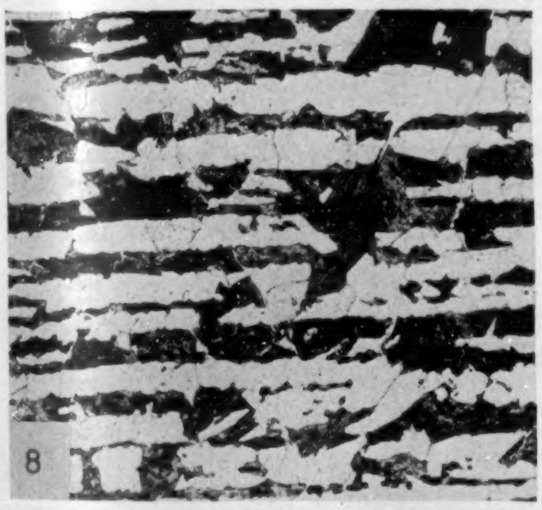


Fig. 8. Steel B, heated at 1570° F., 2½ hours, furnace cooled.

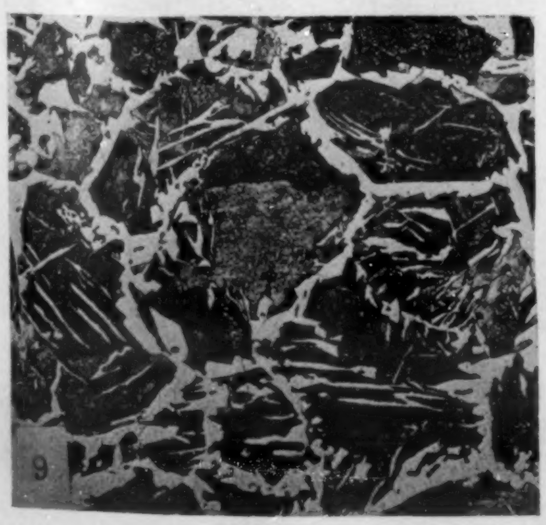


Fig. 9. Steel B, heated at 1600° F., 2 hours, air cooled.

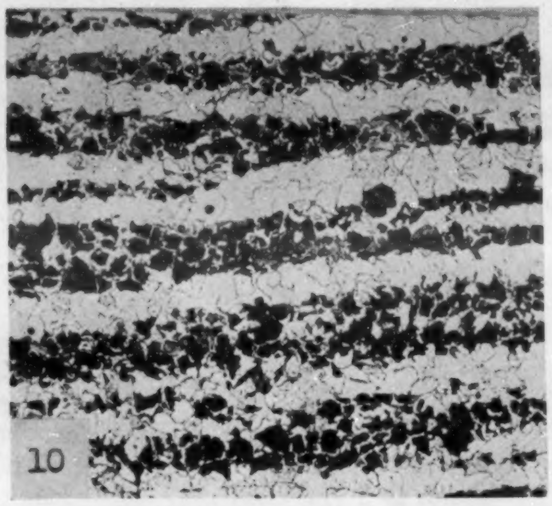


Fig. 10. Steel D, heated at 1590° F., 2½ hours, furnace cooled.

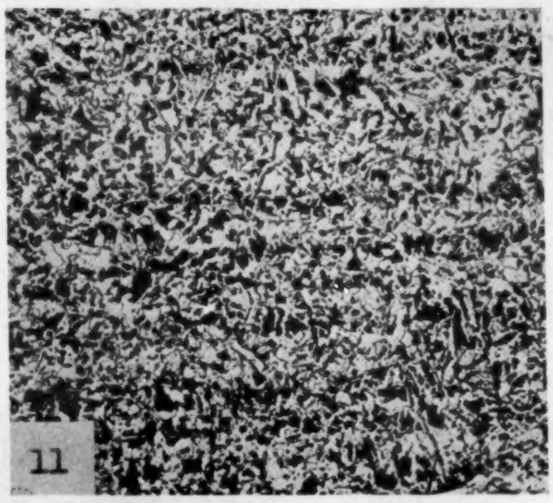


Fig. 11. Steel D, heated at 1615° F., 2 hours, air cooled.

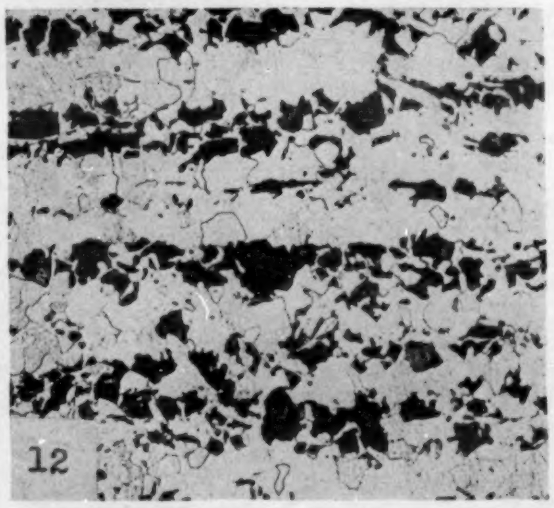


Fig. 12. Steel E, heated at 1675° F., 2½ hours, furnace cooled.

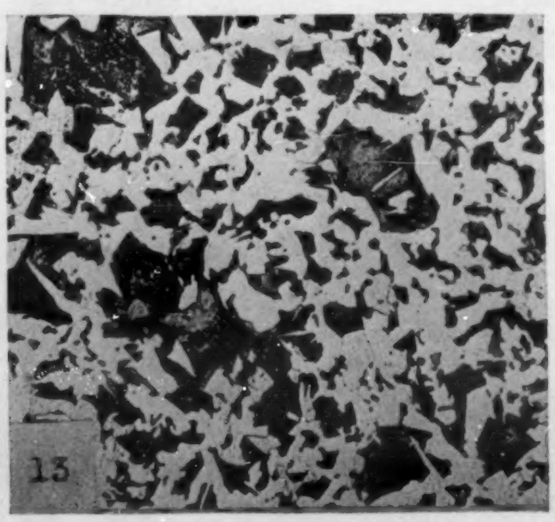


Fig. 13. Steel E, heated at 1700° F., 2 hours, air cooled.

Fig. 14. Steel F, heated at 1670° F., 2 hours, furnace cooled.

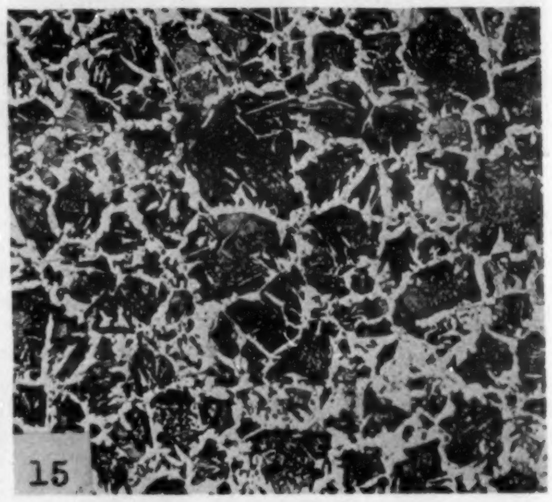


Fig. 15. Steel F, heated at 1695° F., 1 hour, air cooled.

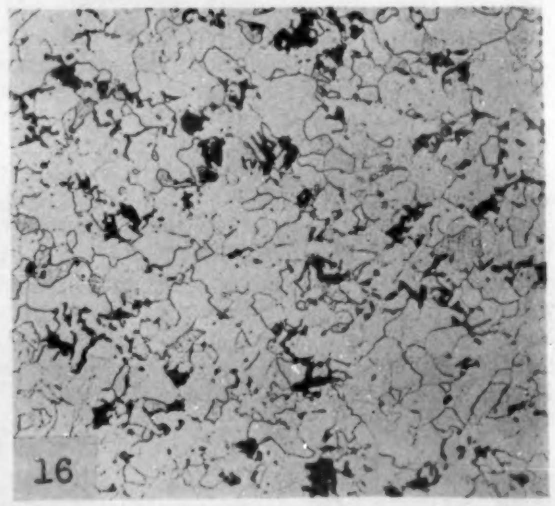


Fig. 16. Steel G, heated at 1670° F., 2 hours, furnace cooled.

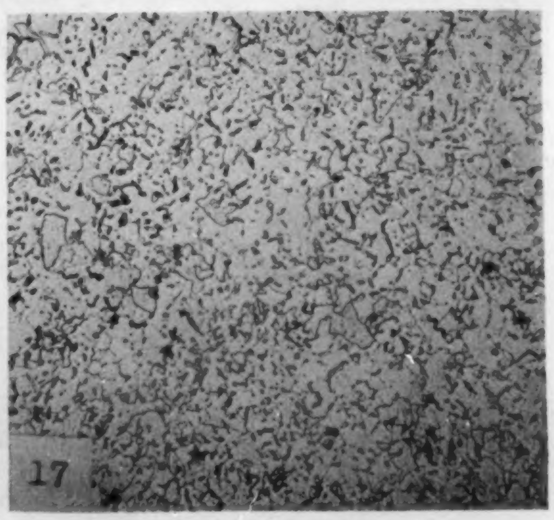
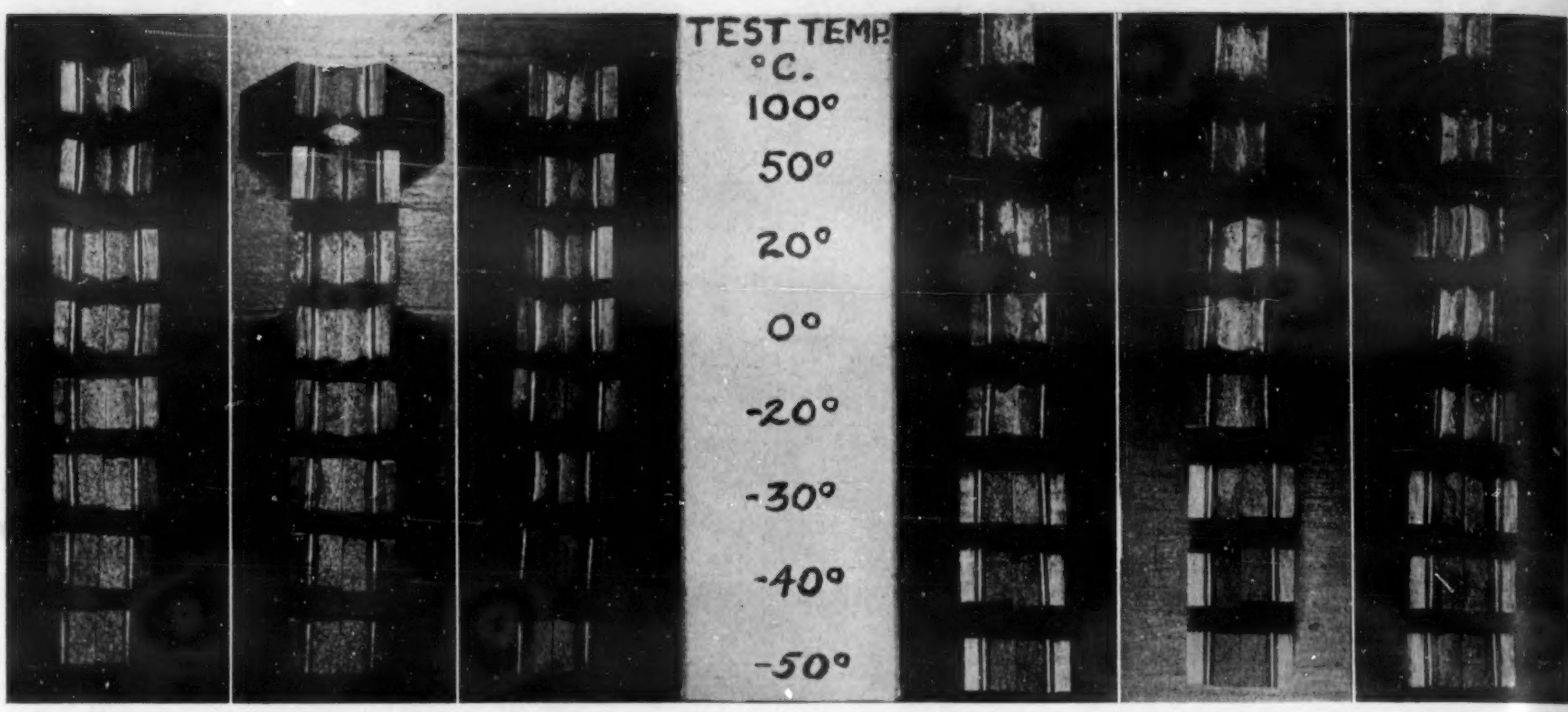


Fig. 17. Steel G, heated at 1695° F., 1½ hours, air cooled.



A B D Steel E F G

Fig. 18. Photograph of Fractured Specimens, Normalized series.

malized and annealed states, but no breaks occur in the temperature range of our tests. The low C Cromansil steel has very high Charpy values at temperatures down to -20° C. Here the change from plastic to cleavage fracture starts to take place, with its accompanying scatter of individual values. At -50° C., this steel still has a fair average Charpy value (17 ft.-lbs.) in the normalized condition.

The carbon steel is tougher in the normalized condition than it is in the fully annealed state. This difference is especially pronounced in the range of temperature just below atmospheric. At 10° C. the normalized steel had a Charpy value of 25 ft.-lbs., while the annealed steel developed only 12 ft.-lbs. At temperatures below 0° C, the steel is notch-brittle in both conditions.

The Mn steel (steel "B"), is somewhat tougher than the C steel under all conditions. The decrease in toughness is not quite as abrupt below room temperatures, and the normalized steel has a Charpy value of 17 ft-lbs. down to -40° C. Recent results by Sergeson[2] included a steel of almost identical chemical composition, excepting for a content of 0.081% P. This steel had lower Charpy values in the normalized condition than the Mn steel tested in this study. In the discussion of this paper, it was suggested by C. C. Henning[3] that the high P content was responsible for the low notch toughness. Our results seem to bear out this point.

The Mn-Si steel (steel "D"), in both conditions of heat treatment, exhibits very desirable Charpy values at low temperatures. The break to cleavage fractures does not take place in the range down to -50° C. In the normalized state, the Charpy value was 29 ft.-lbs., an unusually high notch toughness for so low a temperature. This may be due to the refined grain of this steel. The micrographs show that this steel has a smaller grain size than any of the other plate stocks, in both the annealed and normalized state.

The Cromansil steel (steel "E"), has Charpy values of 30 ft.-lbs. and over in both normalized and annealed conditions above +10° C. At this temperature, the toughness drops off sharply, the normalized steel dropping more rapidly than the annealed. It is tougher than the C steel at all temperatures, but at temperatures below 0° C., it has lower Charpy values than the normalized Mn steel. It was observed that the fractures of the Cromansil steel were somewhat laminated. Possibly the plate of Cromansil steel which we tested is not typical of its analysis because of these laminations.

The ½" Cromansil plate has lower Charpy values in the annealed condition than the annealed "E" Cromansil. This difference may be accounted for by the difference in P content of the 2 metals. The normalized steels behave in about the same way with a sharp reduction in impact values occurring below +10° C.

---

[2]Sergeson. *Transactions American Society for Steel Treating,* Vol. 19, Feb. 1932, pages 368-382.

[3]Discussion of Mr. Sergeson's paper. *Transactions American Society for Steel Treating,* Vol. 19, Feb. 1932, page 383.

Table III. Results of Charpy Notch-Toughness Tests in Foot Pounds

Steel	Heat Treatment	Temperatures of Test in °C. 100	50	20	10	0	-20	-30	-40	-50
A-2½" Plate	Annealed	36.1	27.3	19.1	8.8	4.77	3.0	3.7	2.21	2.13
Carbon Steel		34.9	26.1	17.4	14.5	4.22	3.2	3.0	2.89	2.21
	Normalized	39.8	35.4	29.0	26.4	19.0	4.5	4.0	3.59	2.97
		41.6	32.6	25.9	24.3	13.1	4.4	3.9	3.15	2.97
B-2¾" Plate	Annealed	35.8	28.7	21.6		4.77	3.8	3.4	3.06	2.97
Manganese		38.7	26.3	20.5		20.5	12.4	3.3	2.55	2.97
Steel	Normalized	47.9	41.0	33.2		13.1	16.8	16.2	19.2	3.77
		45.1	40.3	28.4		26.0	20.5	20.8	14.3	3.42
D-1½" Plate	Annealed	41.3	32.1	26.1		24.2	19.1	19.1	21.2	17.3
Manganese		42.1	33.5	28.6		24.2	20.5	19.1	19.2	17.9
Silicon	Normalized	51.5	52.8	44.6		41.3	33.8	35.0	33.4	26.1
Steel		52.9	53.3	45.4		42.9	35.4	34.6	36.6	31.8
E-2½" Plate	Annealed	41.3	38.4	33.7	32.0	26.3	18.6	7.9	5.20	3.86
Cromansil		38.0	39.6	27.3		28.1	20.1	8.8	12.10	5.33
Steel									4.59	
	Normalized	41.9	44.7	36.3	29.5	23.2	8.5	4.0	3.68	3.15
		40.6	47.8	47.8	36.5	27.9	10.5	4.7	4.50	2.97
				36.1		27.0				
F-½" Plate	Annealed	27.0	22.1	17.7	16.8	10.3	4.8	3.9	2.55	3.15
Cromansil		27.4	21.9	20.3	12.2	15.6	6.9	3.0	2.80	2.97
Steel	Normalized	53.1	46.1	39.3	36.3	21.9	15.4	12.9	4.59	5.71
		51.0	42.9	39.3	37.2	30.3	16.3	10.7	10.96	5.62
						37.2			5.24	
G-1" Round	Annealed	66.3	56.8	61.9	54.7	53.3	53.1	45.4	47.3	33.1
Low Carbon		67.9	56.5	56.5		58.4	30.3	39.3	36.3	3.95
Cromansil							49.6		34.6	42.1
Steel	Normalized	67.9	60.4	51.5	50.8	44.7	45.4	29.0	33.7	14.1
		69.8	59.2	52.4	57.2	43.9	44.2	40.3	19.2	19.0
								32.1	13.1	

Table IV. Hardness Readings

Steel	Rockwell "B"	Brinell
A—Carbon Steel		
Annealed	59.1	103
Normalized	62.5	104
B—Manganese Steel		
Annealed	76.2	134
Normalized	81.0	146
D—Manganese—Silicon Steel		
Annealed	77.5	140
Normalized	84.5	163
E—2½" Cromansil Steel		
Annealed	78.8	140
Normalized	79.5	141
F—½" Cromansil Steel		
Annealed	80.0	146
Normalized	89.5	172
G—Low Carbon Cromansil Steel		
Annealed	73.5	125
Normalized	76.6	138

The low C Cromansil steel, as previously mentioned, had the highest Charpy values of all the steels tested in the temperature range above -20° C. At room temperature, the normalized

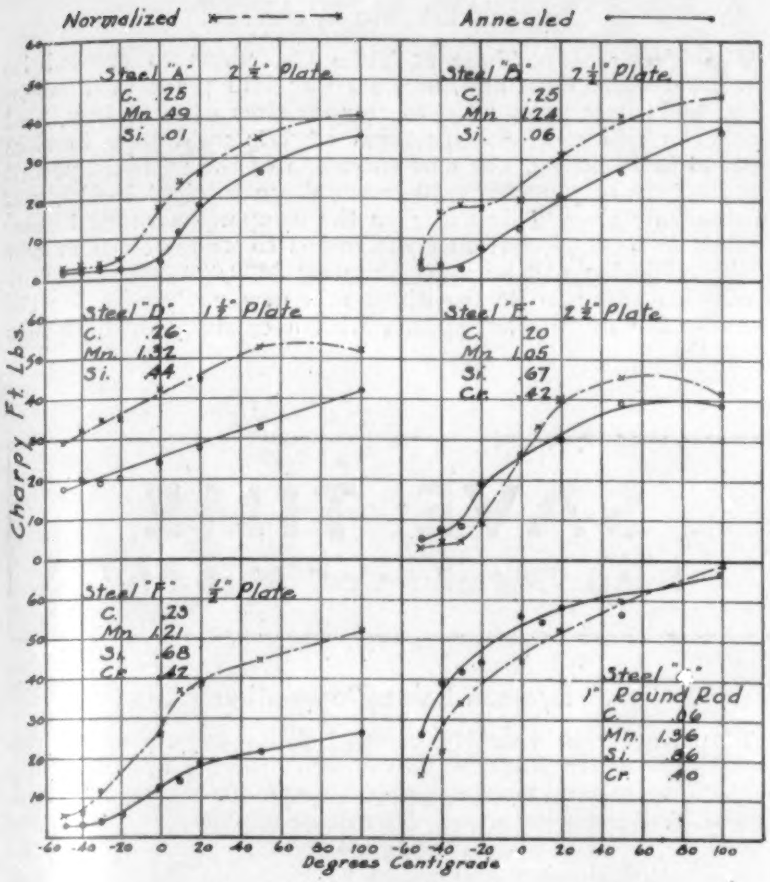


Fig. 19. Notch Toughness of Low Alloy Steels.

steel had a toughness of 52 ft.-lbs., and the annealed steel, 59 ft.-lbs. In this steel a gradual decrease in toughness took place down to -20° C. Below -20° C., the drop in impact value was more rapid, and the individual values were scattered. Despite the rapid decrease in impact value, at -50° C., this steel still broke with considerable plastic deformation, and its average notch toughness was 16 ft.-lbs. in the normalized condition, and 26 ft.-lbs. in the fully annealed state. The micrographs show that this steel has a fine grain size which may account for the high notch toughness persisting to the lower temperatures, as mentioned in the discussion of the "D" steel.

The investigation of the effect of direction of rolling and position in the plate, showed only slight differences between the various specimens. These results are given in Table V.

All these tests were made at -20° C., on specimens of C steel. Since all of the values are so low, it is difficult to draw any conclusions regarding the variables we intended to study. A similar series of tests, run at room temperature or higher, may show up differences which are not apparent in this test.

Table V. Special Charpy Tests

Effect of Direction of rolling		Effect of Position in Block	
Parallel	Charpy ft.-lbs.	Plate surface	Charpy ft.-lbs.
A 31	3.8	A 41	3.8
32	3.9	44	3.9
Transverse		Center of Block	
A 133	3.8	A 42	4.0
34	3.7	A 45	4.1
		½" from plate surface	
		A 36	3.8
		A 46	3.8

SUMMARY

1. The C steel, the Mn steel, and the .25% C Cromansil steels exhibit a sharp drop in the notch toughness below +10° C.
2. The low-C Cromansil steel has higher Charpy values at all temperatures than those with higher C content, and lowers the range of sudden drop of impact resistance to -20° C.
3. The Mn-Si steel does not have any break in its impact resistance at low temperature. There is a gradual decrease in impact resistance down to -50° C.
4. At room temperature, the steels with successive additions of Mn, Si and Cr to the .25% C steel showed corresponding increases in impact resistance.
5. As the temperature of test is decreased, the relative toughness of the various alloy steels changes.
6. There is no relation between the hardness of the materials tested and their notch toughness.

ACKNOWLEDGMENTS

The authors wish to express their thanks to Prof. T. McLean Jasper and Dr. Samuel L. Hoyt for the helpful suggestions given them in the technique of testing and interpretation of results. We are also grateful for the assistance given us by Messrs. L. J. Larson, John Bock, and Lorenz Heise. We also wish to thank the A. O. Smith Corporation for the use of their equipment for machining and testing, and for some of the steels used in this study; the Lukens Steel Company, and the Electro Metallurgical Company who furnished the Cromansil steels.

Bibliography

[1]L. Aitchison and others. Notched-Bar Impact Tests at Low Temperatures. *Report* No. 922, *Aeronautical Research Committee,* Vol. 2, 1924/25, page 518.

[2]H. A. Anderson. Zinc Alloys for High and Low Temperature Service. *Symposium on Effect of Temperature on Metals, American Society for Testing Materials—American Society of Mechanical Engineers,* 1931, page 271.

[3]F. W. Bremmer. Development of Casing for Deep Wells. *Transactions American Institute Mining & Metallurgical Engineers,* Vol. 90, Iron & Steel Division, 1930, page 293.

[4]R. A. Bull. The Performances of Cast Carbon and Low-Alloy Steels in High and Low Temperature Service. *Symposium on Effect of Temperature on Metals, American Society for Testing Materials—American Society of Mechanical Engineers,* 1931, page 260.

[5]J. Bunting. The Brittle Range in Brasses as Shown by the Izod Impact Test. *Journal Institute of Metals,* Vol. 31, 1924, page 47.

(Bibliography continued on next page)

[6]A. Campion & J. W. Donaldson. Some Influences of Low Temperature on the Strength and Properties of Cast Iron. *Foundry Trade Journal,* Vol. 26, July 13, 1922, page 32.

[7]Pierre Chevenard. Etude de la Fragilité des Ferronickels aux basses Temperatures. *Revue de Métallurgie* (Memoires), Vol. 19, 1922, page 209.

[8]C. L. Clark & A. E. White. Comparative Physical Properties of Chromium-Nickel, Chromium-Manganese, and Manganese Steels. *Transactions American Society of Mechanical Engineers,* Vol. 53, 1931, Fuels & Steam Power, page 177.

[9]J. Dewar & R. A. Hadfield. Effect of Liquid Air Temperatures on the Mechanical and other Properties of Iron and Its Alloys. *Proceedings Royal Society,* London, Vol. 74, 1904, page 326.

[10]P. Goerens & R. Mailänder. Cold and Hot Brittleness of Steel and Some Other Metals (Copper, Zinc, Nickel) in the Tensile Test. *Journal Institute of Metals,* Vol. 40, 1928, page 610.

[11]H. K. Gough & A. J. Murphy. Effect of Low Temperatures on the Shock Resistance Properties of New Wrought Iron Chains. *Proceedings Institution Mechanical Engineers,* Vol. 2, 1930, page 1159; abstract, *Engineering,* Vol. 130, 1930, page 67.

[12]R. Greaves & J. Jones. The Effect of Temperature on the Behavior of Metals and Alloys in the Notched-Bar Impact Test. *Journal Institute of Metals,* Vol. 34, 1925, page 85.

Effect of Temperature on the Behavior of Iron and Steel in the Notched-Bar Impact Test. *Journal Iron & Steel Institute,* Vol. 112, 1925, page 123.

[13]L. Guillet & J. Cournot. Sur la Variation des Proprietes mecaniques de quelques Metaux et Alliages aux basses Temperatures. *Revue de Métallurgie* (Memoires), Vol. 19, 1922, page 215.

[14]W. A. Güldner. Ueber die Kerbzähigkeit einiger Aluminiumlegierungen insbesondere bei tiefen Temperaturen. *Zeitschrift für Metallkunde,* Vol. 22, 1930, pages 257, 412.

[15]R. A. Hadfield. Experiments Relating to the Effect on Mechanical and Other Properties of Iron and Its Alloys Produced by Liquid Air Temperatures. *Journal Iron & Steel Institute,* Vol. 67, 1905, page 147.

[16]J. J. Hruska. Study of the Pearlitic Manganese Steels. *Heat Treating & Forging,* Vol. 16, 1930, page 598; *Blast Furnace & Steel Plant,* Vol. 18, 1930, page 1463.

[17]A. B. Kinzel. Silicon-Manganese Steels with Chromium Additions for Engineering Applications. *Transactions American Society for Steel Treating,* Vol. 14, 1928, page 866.

[18]A. B. Kinzel & W. B. Miller. Data on Manganese Structural Steels with Chromium Additions. *Transactions American Society for Steel Treating,* Vol. 18, 1930, page 908.

[19]F. Körber & A. Pomp. Einfluss der Vorbehandlung auf die Kerbzähigkeit des Flusseisens in der Kälte und Wärme. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 7, 1925, page 33.

[20]F. Körber & A. Pomp. Einfluss der Vorbehandlung auf die mechanischen Eigenschaften von Kohlenstoff- und legiertem Stahl, insbesondere die Kerbzähigkeit in der Kälte und Wärme. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 7, 1925, page 43.

[21]A. Krupkowski & W. J. de Haas. Properties of Nickel Copper Alloys at Low Temperatures. *Proceedings Academy of Sciences* (Amsterdam), Vol. 32, 1929, page 912.

[22]A. Krupkowski & W. J. de Haas. Properties of Nickel-Copper Alloys at Low Temperatures. *Proceedings Academy of Sciences* (Amsterdam), Vol. 31, 1928, page 687.

[23]F. C. Langenberg. An Investigation of the Behavior of Certain Steels under Impact at Different Temperatures. *Iron & Steel Institute, Carnegie Scholarship Memoirs,* Vol. 12, 1923, page 75.

Investigation of the Influence of Temperature on the Charpy Impact Value of a Group of Steels of Varying Compositions. *Yearbook American Iron & Steel Institute,* 1923, page 349.

[24]P. Ludwik. Streckgrenze, Kalt- und Warmsprödigkeit. *Zeitschrift des Vereins deutscher Ingenieure,* Vol. 70, 1926, page 379.

[25]R. W. Moffatt. The Effect of Low Temperatures upon the Impact Resistance of Steel Castings. *Canadian Journal of Research,* Vol. 2, 1930, page 327.

[26]I. F. Morrison & A. E. Cameron. The Impact of Steels at Low Temperature. Paper presented at Jasper Meeting, Empire Mining & Metallurgical Congress. *Transactions Canadian Institute Mining & Metallurgy,* Vol. 30, 1927, page 839.

[27]Max Moser. A New Method of Interpreting Notched Bar Impact Test Results. *Transactions American Society for Steel Treating,* Vol. 7, 1925, page 297.

[28]I. Musatti. Dynamic Properties of Magnesium Alloys. *La Metallurgia Italiana,* Vol. 22, 1930, page 1052.

[29]C. Pardun & E. Vierhaus. Eigenschaften von Gusseisen bei niedrigen Temperaturen unter besonderer Berücksichtigung von Gussrohren und Gussrohrleitungen. *Die Giesserei,* Vol. 15, 1928, page 99; abstract, *Foundry Trade Journal,* Vol. 38, 1928, page 298.

[30]A. Pomp. Properties of Steel at High and Low Temperatures. *Metallurgist,* Vol. 4, 1928, page 13.

[31]M. F. Robin. La Durete des Aciers aus basses Temperature. *Revue de Métallurgie,* Vol. 6, 1909, page 162.

[32]W. Rosenhain & A. J. Murphy. Metallography at Low Temperatures. *Journal Royal Microscopical Society,* Vol. 50, 1930, page 316.

[33]H. W. Russell. Effect of Low Temperatures on Metals and Alloys. *Symposium on Effect of Temperature on Metals, American Society for Testing Materials—American Society of Mechanical Engineers,* 1931, page 486.

[34]P. Schoenmaker. Zerreiss- und Schlagversuche bei tiefen Temperaturen. *First Communications New International Association for Testing Materials,* Group A, 1930, page 237.

[35]R. Sergeson. Behavior of some Irons and Steels under Impact at Low Temperatures. *Transactions American Society for Steel Treating,* Vol. 19, 1932, page 368.

[36]L. W. Spring. Industrial Application of Metals at Various Temperatures. *Proceedings American Society for Testing Materials,* Vol. 24, Part II, 1924, page 11; discussion, page 142.

[37]W. P. Sykes. Effect of Temperature, Deformation, Grain Size and Rate of Loading on Mechanical Properties of Metals. *Transactions American Society of Mining & Metallurgical Engineers,* Vol. 64, 1920, page 780.

[38]R. Yamada. On the Impact Test of Steels at Low Temperature. *Science Reports Tohoku Imperial University,* Vol. 15, 1926, page 631.

[39]R. Mailänder. Der Einfluss der Probenbreite auf die Kerbzähigkeit von Flusseisen. *Krupp'sche Monatshefte,* Vol. 5, 1924, page 16.

Expands Electric Weld Mill

The Youngstown Sheet & Tube Co. plans to expand its present electric weld mill, at its Briar Hill plant in Youngstown, to include production of smaller sizes of electric welded pipe. The mill now manufactures electric weld pipe in sizes from 18 to 26 inches. The new extension of the mill will permit manufacture of pipe from 16 inches down to eight inches, and intermediate sizes. This will give the company a range in size of electric weld pipe from eight inches to 26 inches. The cost of the extension will be approximately $500,000. The company is also installing in its Struthers mill new equipment for the manufacture of railroad spikes, with a capacity of 1000 tons a month.

Ryerson Sales Convention

A special train recently completed its cross-country run from the Atlantic Seaboard to Chicago bringing a large group of the marketing organization of Joseph T. Ryerson & Son, Inc., largest independent steel-service company. The units began to collect at Boston, picking up the New York contingent, then the Philadelphia and so on to Chicago. The Cincinnati, Cleveland, Detroit, St. Louis and Buffalo groups used special cars from their plants, while Milwaukee motored down. The men proceeded immediately to the Ryerson Chicago Plant to take part in the three-day National Sales Convention arranged by H. B. Ressler, vice president in charge of sales. President Edward L. Ryerson, Jr., welcomed the group at the opening session and later discussed the situation and problems of the coming year. Mr. Everett Graff, executive vice president, outlined the current position and immediate objectives. The sessions were devoted to talks and discussions of the changing industrial conditions, objectives for 1934, advertising, sales promotion, the newer Ryerson products, improved selling methods, etc. As the Ryerson Chicago Plant is the largest and most modern steel-service plant in the world, an intensive study was made of Chicago stocks, facilities and operating methods. The occasion closed with a banquet at the Union League Club. While many divisional sales meetings are regularly held by the company, this is the first time the whole organization has been assembled at one convention. There were over 200 men in attendance at the various sessions.

A. F. A. Annual Convention, Exposition and International Foundry Congress

Executive Secretary C. E. Hoyt announces that the Board of Directors of the American Foundrymen's Association has voted unanimously to hold the 1934 Convention and Exhibition of the association in Philadelphia, and to arrange a convention without an exhibition for 1935. The executive secretary also announces that the International Committee of foundry technical associations has awarded to the American Foundrymen's Association the honor of holding in the United States in 1934, the Fifth International Foundry Congress and Exposition. The staging of this important event in connection with the annual convention of A.F.A., which is usually held in May, has been set for the week of October 22, a date following the annual conventions of the coöperating European associations. The meetings, exposition, and International Congress will be held in Philadelphia's new auditorium, one of the largest and most completely equipped convention halls in the world. The overseas countries whose foundry associations are members of the Committee on International Congresses include Great Britain, Spain, Belgium, Czechoslovakia, Italy, France, Germany and Holland. The first International Foundry Congress was held in Paris, France, in 1923; the second in Detroit, U.S.A., 1926; the third in London, England, 1929; and the fourth in Paris, France, 1932. Sixteen foreign countries were represented in the attendance at the International Congress in Detroit. It is the plan of the directors that the 1935 convention without an exhibit shall be similar in character to the very successful one held at the Edgewater Beach Hotel in Chicago, in June, 1927, following the International Foundry Congress held in Detroit in the fall of 1926.

PRODUCTION OF PURE CHROMIUM*

by P. P. Alexander

THE chromium at present available for industrial purposes is produced by methods which do not eliminate all the impurities. The resulting metal, therefore, usually contains appreciable amounts of carbon, aluminum, silicon, oxygen or nitrogen.

In 1797 Vauquelin[2] reduced chromic oxide to metallic chromium by heating a mixture of chromic oxide and carbon in a graphite crucible. Since that time chromic oxide has been reduced by a number of investigators, using various reducing agents. Besides carbon should be mentioned boron,[3] aluminum,[4] magnesium,[5] calcium,[6] silicon,[7] calcium silicide,[8] aluminum silicide,[9] calcium carbide[10] and hydrogen. This last reagent has been used by a number of investigators,[1,11,12,13,14,15,16] since it gave promise of obtaining chromium with only those impurities which were left in the chromic oxide after its purification.

The successful use of hydrogen, however, requires that it should be of an extraordinary degree of purity, since even a trace of oxygen is sufficient to completely stop the desired reaction. To produce hydrogen of such purity in large volumes, is, of course, a problem of considerable complexity. The reduction of chromic oxide, furthermore, results in a continuous generation of moisture which should be instantly removed from the crucible, otherwise all the trouble of the purification and drying of hydrogen would be of no avail.

To overcome this fundamental difficulty of the reduction of chromic oxide with hydrogen, that gas must be passed over the oxide in a rapid flow. The amount of energy necessary to preheat the large volume of hydrogen is considerable. In some cases, it is even greater than the energy necessary to heat the furnace itself, which, of course, makes the process very inefficient.

In undertaking this research work it was hoped to find such methods of producing and conveying the pure hydrogen that the above indicated difficulties would be eliminated.

Preparation of Pure Chromic Oxide

Most of the experimenters, in preparing pure chromium, used, as a starting point, ammonium chromate. In this investigation, it was decided to start with the compound from which the ammonium chromate was produced. Chromium trioxide was selected, therefore, as a starting point in this work.

Chromium trioxide volatilizes at a low temperature and therefore can be either sublimed or distilled. It was found that the best results were obtained by distillation at a temperature slightly above the melting point of that compound, that is, in the range of 200°-210°C. To increase the rate of distillation, the pressure in the apparatus was maintained at a low value of about 1 mm. The spectrographic analysis of the obtained product was as follows: sodium— trace; iron, calcium, silicon, manganese, potassium, aluminum and magnesium—none.

The distilled chromium trioxide was converted into chromic oxide by placing it in a vacuum furnace heated to a temperature of 850°C. As the temperature of the chromium trioxide was very quickly raised to a point beyond that at which it was transformed into a stable chromic oxide, the loss by distillation was negligible. The produced chromic oxide was, of course, of the same purity as the distilled chromium trioxide.

*Abridgment of thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Science in Metallurgy, Massachusetts Institute of Technology.

Reduction of Chromic Oxide into Metallic Chromium

The first preparation of pure metallic chromium was accomplished by Faehr,[16] who in 1908, succeeded in obtaining metallic chromium of 99.96% purity. His method of preparing pure hydrogen, and treating chromic oxide with it, was so elaborated that it could be used only on a very small scale. The average weight of his samples was only 0.17 grams.

More recent studies of von Wartenberg[17] showed that the ratio, pH_2O/pH_2, must be about 0.001 for the reduction of chromic oxide with hydrogen at 1100°C.

To avoid the necessity of using large amounts of hydrogen, the author conceived the idea of using the hydrides of such elements as palladium, tantalum, columbium, zirconium, calcium, et cetera.

These hydrides are stable at a moderately high temperature and at a normal pressure. Yet, when subjected to a temperature above red heat, and especially at a reduced pressure, they decompose and furnish a large volume of pure, dry hydrogen.

Experiments with Tantalum Hydride

In selecting a suitable hydride-forming element for the first series of experiments, tantalum was preferred.

The researches of von Pirani indicated[18] that tantalum absorbs, at 1000°C., 740 volumes of hydrogen. The solubility of hydrogen in tantalum increases up to 1330°C., above which temperature it remains constant.

Tantalum hydride, which is formed during this absorption of hydrogen, can be easily decomposed at red heat by subjecting it to a reduced pressure.

The behavior of tantalum toward oxygen was also taken into consideration. As has been shown by the researches of Siemens and von Bolten,[19] tantalum does not combine with oxygen at pressures below 20 mm. In fact, if tantalum, contaminated with oxygen, is heated in a high vacuum, oxygen will be expelled.

The first experiments were conducted with powdered tantalum intimately mixed with chromic oxide which was reduced during the subsequent treatment with the hydrogen evolving from the tantalum particles.

Later it was found possible to use tantalum plates with chromic oxide spread between them in a thin layer of about 1 mm. in thickness.

The usual procedure of the experiments was as follows: the tantalum plates, with the layer of chromic oxide between them, were placed in the quartz tube, sealed at one end. The other end was connected to the supply of commercially pure hydrogen, containing 0.3% oxygen.

The end of the quartz tube containing the sample was inserted into an electric furnace maintained at a temperature of 1000°C. During this operation, the tantalum plates absorbed only hydrogen from the gas present in the tube. The small percentage of oxygen, present in hydrogen, has no effect either on tantalum or on chromic oxide.

The second operation was that of connecting the quartz tube with the vacuum pump, and reducing the gas pressure to about 1 mm. of mercury. The formed tantalum hydride in the tantalum plates was quickly decomposed and a large volume of pure hydrogen swept over the layer of chromic oxide. The moisture, produced by the reduction of chromic oxide, was withdrawn by the vacuum pump from the tube as fast as is was formed,

so that the ratio between the moisture and hydrogen was always kept at a very low value. The entire cycle of these operations necessitated 30 minutes.

The tantalum plates play the role of a storage reservoir for pure hydrogen, which can be kept in storage or released at any definite time or rate, simply by regulating the temperature and the pressure of the gas in the tube.

From time to time, however, the tantalum plates should be given suitable treatment to correct the excessive brittleness produced by the hydrogen.

The spectrographic analysis on the metallic chromium prepared by this method was as follows: sodium—trace; calcium, silicon, manganese, magnesium, aluminum, iron and potassium—none.

Reduction of Chromic Oxide with Calcium Hydride

Calcium hydride was used for the next experiments. Moissan[20] was the first to prepare this compound by subjecting calcium, at red heat, to the action of hydrogen. Under these conditions, calcium becomes incandescent and burns in hydrogen with great rapidity, forming a fused mass which is calcium hydride. The compound prepared by this method is quite stable in dry air, at temperatures up to that of red heat, and it can even be calcined in an open crucible for long periods without decomposition. But if the pressure of the surrounding gas is reduced, the calcium hydride does decompose.

One cc. of calcium hydride when rapidly dissociated, will supply, at the temperature of red heat, about 3100 cc. of hydrogen. This sudden generation, in the reaction chamber itself, of a large amount of gas, would determine a blast strong enough to sweep away other gases which might be present.

Another reason for selecting calcium hydride for the purpose of reducing refractory oxides, was, that the decomposition of calcium hydride liberates calcium, as well as hydrogen.

When the moisture, produced during the reduction of chromic oxide, comes in contact with calcium, it is instantly decomposed. The liberated hydrogen is available for the further reduction of chromic oxide, and the oxygen combines with calcium, forming refractory calcium oxide.

In other words, the dissociation of calcium hydride produces in the reaction chamber, a large volume of pure, dry hydrogen, and also supplies the most effective means for the elimination of the produced moisture. The ratio of pH_2O/pH_2 is therefore kept every instant at a very low value, and the reaction can proceed at high speed to completion.

The vapor pressure of calcium hydride was investigated by Hansen,[21] and is given by him as follows:

Vapor Pressure of Calcium Hydride

Temperature °C.	Vapor pressure in mm. of mercury
650	28.1
675	66.3
712	143.6
735	269.5
750	410
780	653.5
795	854

In order to reach these equilibrium values, a certain length of time is required. If the temperature is being raised at a sufficiently rapid rate, it is possible to reach considerably higher temperatures before an appreciable amount of calcium hydride is dissociated.

Since the operating temperature was in the range of 900° to 1200°C. refractory materials were not needed. Instead, chromium-plated pure iron retorts were used. The problem of the vacuum system was also greatly simplified by the choice of suitable temperatures.

During the rapid decomposition of calcium hydride above 1000°C., there was a sudden evolution of hydrogen and a considerable increase in pressure. The role of the vacuum pumps was reduced to that of the efficient withdrawal of the surplus produced gas. This surplus, however, was allowed to escape into the atmosphere or a storage tank. The vacuum system therefore became superfluous. The subsequent work demonstrated that with more thorough mixing of the powdered materials and by using the vacuum to start the reaction it is possible to obtain complete reduction below the red heat temperature. Chromic oxide was completely reduced with calcium hydride at *470°C.* in 30 minutes.

In order to separate metallic chromium from calcium oxide, each charge, after treatment, was leached with a dilute solution of nitric acid.

Purity of Produced Chromium

In this method of preparing chromium, the impurities in the produced metal could come either from the chromic oxide or from the calcium hydride.

Chromic oxide was prepared by the distillation and decomposition of chromium trioxide, therefore, only traces of the other elements could come from this source.

Electrolytic calcium, which can now be obtained of a high degree of purity, can also be further refined by distillation. Calcium hydride, used in these experiments, was prepared from such material.

The samples of chromium produced by this method were dissolved in hydrochloric acid without leaving any residue of chromic oxide or other insoluble compounds, which indicated a complete reduction. The chemical analysis revealed in various samples, the presence of calcium, ranging from traces to 0.04%. It was accepted that the purity of the produced chromium was in the order of 99.95%. Chromium reduced between the tantalum plates, with the exception of a trace of sodium, was spectroscopically pure.

The above method of reducing chromic oxide was applied to thorium oxide, boron oxide, beryllium and vanadium oxide. The equipment, temperatures and the technic of handling were in every case very similar, varying only in respect to temperature and the nature of the crucibles.

The moderate temperatures, simplicity of the equipment and the possibility of controlling the purity of the raw materials indicate that this method of reducing refractory oxides would be reasonably inexpensive, and would give a product of any desired purity.

Acknowledgment

To Dr. R. S. Williams, under whose direction this work was done, the author wishes to express his appreciation. As teacher, leader and friend he has kept in close touch with the work. His keen understanding of the personal, as well as the scientific side of the research, has been of great help. On several occasions of discouragement, when meeting with seemingly insurmountable obstacles, his advice has been an inspiration to go ahead and bring this research work to the desired conclusion.

To Prof. Elihu Thomson, in whose Research Laboratory this research was carried out, the author wishes to express his gratitude.

To Dr. I. Langmuir, the author is indebted for his generous willingness on several occasions to analyze his problems and to give scientific interpretation of the facts observed by the author.

To the management of the River Works of the General Electric Company, the author is especially grateful for their sympathetic understanding and for all possible help and encouragement in his work.

References

[1]M. N. Rich. U. S. Patent No. 1741955.
[2]L. N. Vauquelin. *Journal de physique, theoretique et appliquee,* Vol. 45, 1794, page 393.
[3]A. Binet du Jassoneix. *Comptes Rendus,* Vol. 143, 1906, page 897.
[4]H. Goldschmidt, L. Frank, T. Fujicayashi & T. Goldschmidt. *Liebig's Annalen der Physik,* Vol. 267, 1892, page 239.
[5]T. Goldschmidt, M. leBlanc & G. Dollner. German Patents Nos. 96317 and 112486, 1895.
[6]A. Burger. Reduktion durch Calcium. Thesis, Basel, 1907.
[7]B. Neumann. *Zeitschrift für Elektrochemie,* Vol. 14, 1908, page 169.
[8]S. Heuland. French Patent, No. 602448, 1925.
[9]W. D. Berlin. British Patent No. 193057, 1923.
[10]R. Saxon. *Chemical News,* Vol. 70, 1894, page 102.
[11]H. N. Warren. *Chemical News,* Vol. 70, 1894, page 102.
[12]H. von Wartenberg, J. Broy & R. Reinicke. *Zeitschrift für Elektrochemie,* Vol. 29, 1923, page 214.
[13]H. N. Warren & H. von Wartenberg. *Chemical News,* Vol. 55, 1887, page 155.
[14]E. Newbery & J. N. Pring. *Proceedings Royal Society,* Vol. 92A, 1916, page 276.
[15]W. von Rohn. *Zeitschrift für Metallkunde,* Vol. 61, 1924, page 275.
[16]Paul Faehr. Ueber die Reduktion der Metalloxyde der Chromgruppe. Thesis, München, 1908.
[17]H. von Wartenberg & S. Aoyama. *Zeitschrift für Elektrochemie,* Vol. 33, 1927, page 144.
[18]M. von Pirani. *Zeitschrift für Elektrochemie,* Vol. 11, 1905, page 55.
[19]A. Siemens. *Chemical News,* Vol. 100, 1909, page 223.
[20]H. Moisson. *Comptes Rendus,* Vol. 127, 1898, page 29.
[21]C. R. Hansen. Ueber die Zersetzung von Calcium-Wasserstoffverbindungen. Thesis, Darmstadt, 1912.

Method to Determine
Copper and Nickel Plate Thickness
on Steel, Brass and Zinc Die Castings*

by Fred Carl**

In modern electroplating the plate thickness on each base metal must be closely controlled. It was our purpose to develop a fairly rapid method for measuring plate thickness which could be applied as a control check on the thickness of the deposit. Heretofore, the microscopic method of determining plate thickness has, to a large degree, been considered of a research nature, and not fast enough for use as a control method. However, if this method could be adapted for routine or control inspection in copper and nickel plating, it would have certain advantages over the usual chemical method.

Especially is this true where there are 3 layers of plate, for example, nickel—copper—nickel, on steel. Here a chemical analysis would be quite long and would require several separations, while with a rapid microscopic method much work could be saved, and results obtained in a reasonably short time.

Such a method is described below:

Copper and Nickel on Steel

In the case of plating on steel, the finished plated part (without the chromium plate) is first given a 20 to 30 minute plating in a copper cyanide bath using as high a current density as possible without producing "whiskers" on the part. Then the part is plated in an acid copper bath for approximately an hour, again using as high a current density as possible. This can be done in a production lineup. This plating should produce sufficient thickness of copper to protect the edges of the nickel plating and prevent rounding during the subsequent polishing. A specimen is then sawed out of the plated part and is ready to be set in a holder. For this purpose, 2 brass rings about 1" in diameter and about 3/8" wide are used. The specimen is placed inside the 2 brass rings, one ring placed on top of the other, and molten solder is poured into the rings and around the specimen. After the solder is cool, the 2 rings are sawed apart and either ring can now be used for the examination.

The polishing of the specimen is the next step in the preparation. Practically any good method of grinding and polishing metallographic specimens can be used. However, the following method has been found quite successful and fairly rapid, the grinding and polishing requiring about 10 to 15 minutes:

1. Grind on No. 80 Alundum paper.
2. Grind on wheel covered with canvas and using Emery Flour as an abrasive, grinding first across the plating and then with the plating.
3. Polish on wheel covered with Kersey cloth using No. 1 Levigated Alumina as an abrasive, polishing first across the plating and then with the plating.
4. Finish polish on wheel covered with Vel-Chamois cloth using No. 3 Levigated Alumina as an abrasive. The final polishing should be, as in the case of the rough polishing, first across the plating and then with the plating.

(The reason for always finishing with the plating rather than across it is to prevent "smearing" of the nickel into the copper.)

The specimen, after being washed with water is now ready to be etched. The etching in the case of plating on steel is divided into 2 classes,

1. For copper plated directly on steel.
2. For nickel plated directly on steel.

Where a copper plate is applied directly to steel, the etch used is the customary copper or brass etching reagent of the following composition:

NH_4OH—6 parts
H_2O_2 (3%)—1 part

*Paper originally presented before the American Electroplaters Society, Chicago, June 1933.
**Delco Remy Corp., Anderson, Ind.

However, where nickel plate is first applied to the steel, followed by alternate layers of copper and nickel, an etch must be used which will darken the steel to differentiate it from the nickel layer. The following composition was found to give good results for this purpose:

HNO_3—5%
Alcohol—95% —by vol.

If more contrast is desired between the steel and the plating, an etch of the following composition has been found satisfactory:

Glycerine—3 parts
Conc. HF—2 parts
Conc. HNO_3—1 part

This acid etch must then be followed by the H_2O_2—NH_4OH etch in order to bring out the structure of the copper. In the case where the etching has been carried too far, either in the acid or the H_2O_2—NH_4OH solution, the specimen must be repolished, beginning with the canvas covered wheel using emery flour as an abrasive. In most cases, over-etching will be noticed as a broadening of the junction lines between the copper and nickel. This is caused by too prolonged etching with H_2O_2—NH_4OH solution. However, where a definite distinction between acid and cyanide copper is desired, a slight over-etching of the copper may have to be resorted to in order to bring about the desired results.

Copper and Nickel on Brass

The preparation of the specimen is essentially the same as in the case of plating on steel. However, due to the fact that the base metal is nearer the hardness of the solder used in the setting of the specimen, it is only necessary to apply a comparatively thin protective plate of copper. Usually 20 to 30 minutes in a cyanide bath will give sufficient thickness to protect the edge and give contrast to the final nickel layer. The polishing of the specimen is the same as in the case of plating on steel, the time spent in polishing generally being somewhat shorter.

Since the base metal (brass) and the copper plating are both attacked by the usual NH_4OH—H_2O_2 solution, the etching of the specimen becomes quite simple. In the case of over-etching, the polishing should be repeated, beginning with the canvas wheel and emery flour abrasive.

Copper and Nickel on Zinc Die Castings

The preparation for examination of this type of plated work is similar to that of plating on brass. Only a comparatively thin plate of cyanide copper is necessary to protect the edges and give contrast to the final nickel plate. In a cyanide copper bath 20 to 30 minutes should give a sufficient layer of copper for this purpose. The polishing of the specimen is the same as was given under plating on steel.

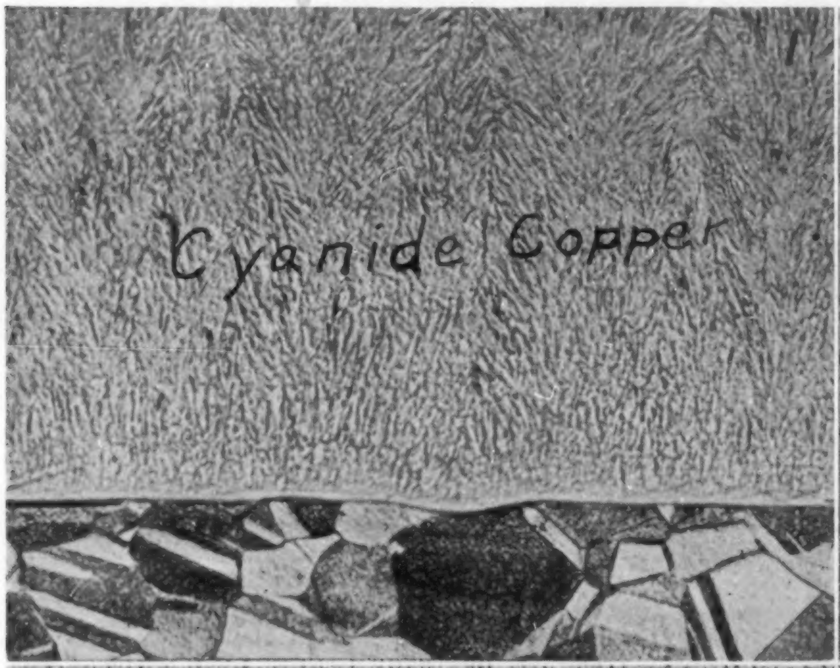
The greatest difficulty in the examination of copper and nickel plating on zinc die castings is in the etching of the specimen. The usual NH_4OH—H_2O_2 solution applied with a cotton swab, as in the etching of plating on steel and brass, attacks the zinc base metal very rapidly and blurs the boundaries between the copper and the zinc base metal to the extent that an examination is practically impossible. Visual examination in the unetched condition was found fairly satisfactory, the only difficulty being that plate boundaries were not distinct. Several electrolytic etches were tried with varying degrees of success, the greatest difficulty with this type of etching being in the pitting produced over the surface and especially in the boundaries. The most successful etch found was in a polish-attack method using the usual NH_4OH—H_2O_2 as the etching solution. With this type of etching, a small quantity of the etching solution is poured on the final polishing wheel,

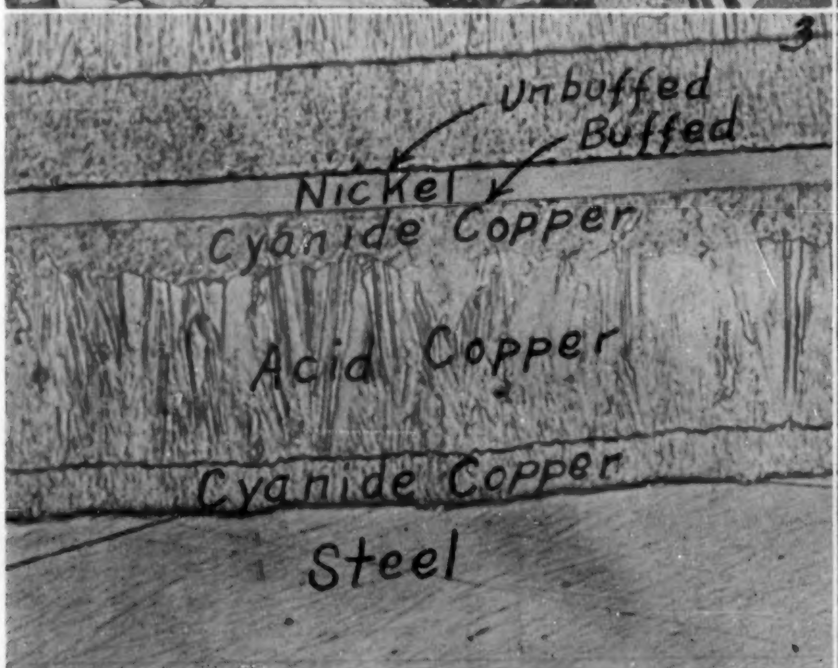
and using a slight pressure, the polished specimen is held against the wheel until the base metal (zinc) has darkened. This generally requires from 3 to 5 seconds for the etching. The specimen is then washed in water and alcohol and dried. Although this method sometimes requires repeated etching, the results obtained were superior to any other method.

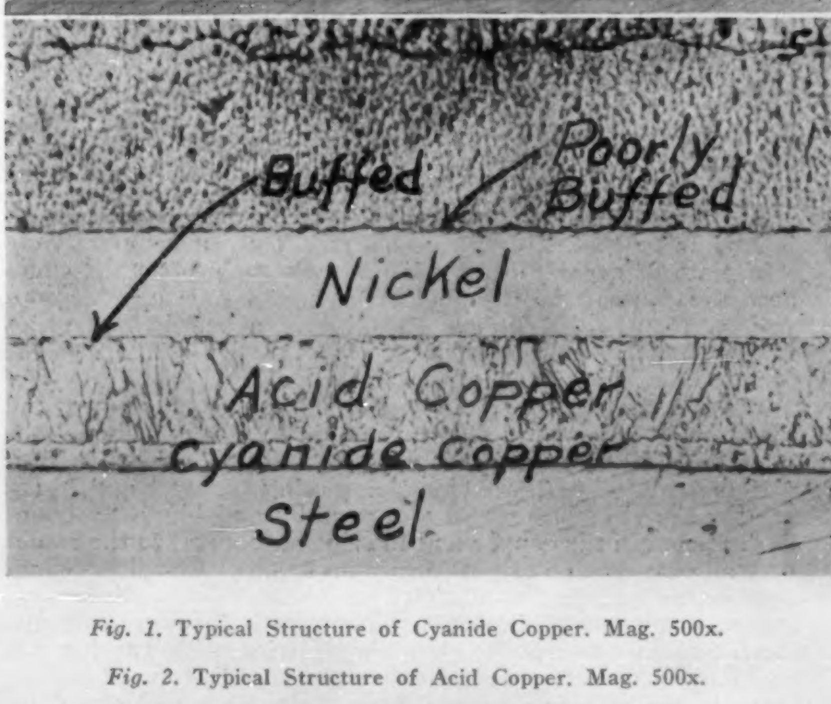
Conclusion

Obviously, there are disadvantages in this method of measuring plate thickness as well as advantages.

First, it requires a metallurgical microscope with a range up to 1000 diameters, and polishing equipment. However, a large number of concerns already maintain a metallurgical







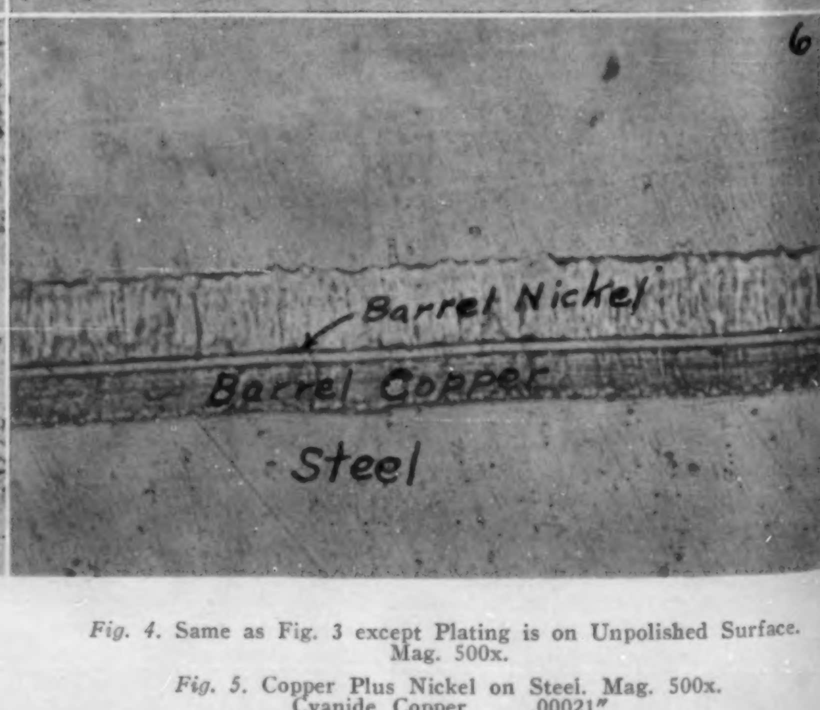


Fig. 1. Typical Structure of Cyanide Copper. Mag. 500x.

Fig. 2. Typical Structure of Acid Copper. Mag. 500x.

Fig. 3. Copper Plus Nickel on Steel. Mag. 500x.

Cyanide Copper	.00043"
Acid Copper	.00162"
Cyanide Copper	.00037"
Nickel	.00031"

Fig. 4. Same as Fig. 3 except Plating is on Unpolished Surface. Mag. 500x.

Fig. 5. Copper Plus Nickel on Steel. Mag. 500x.

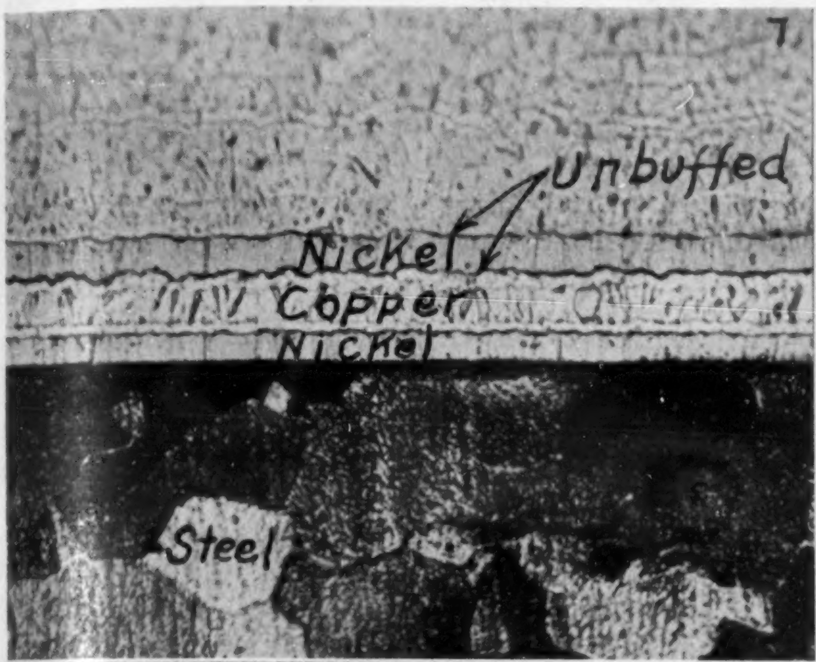
Cyanide Copper	.00021"
Acid Copper	.00112"
Nickel	.00090"

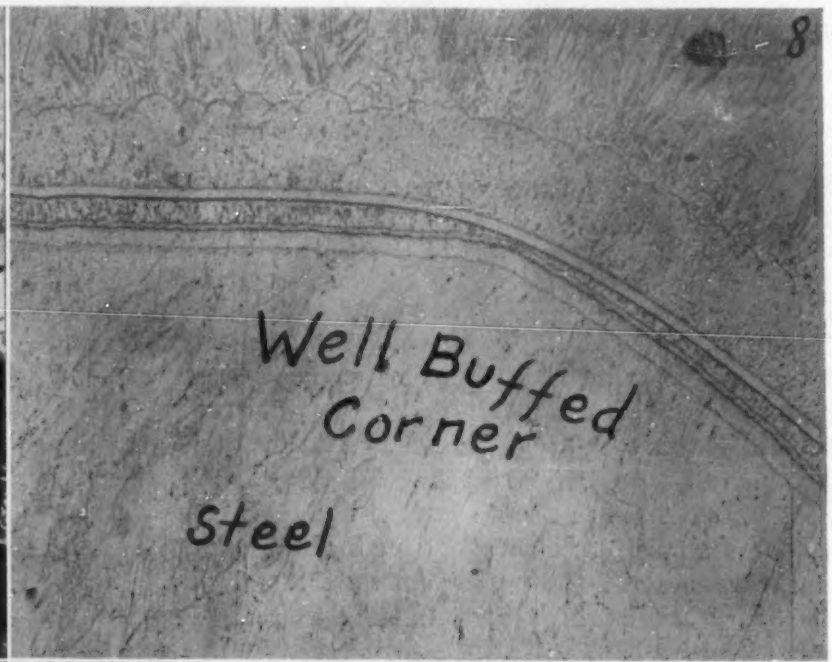
Fig. 6. Copper Plus Nickel on Steel (Barrel Plated). Mag. 500x.

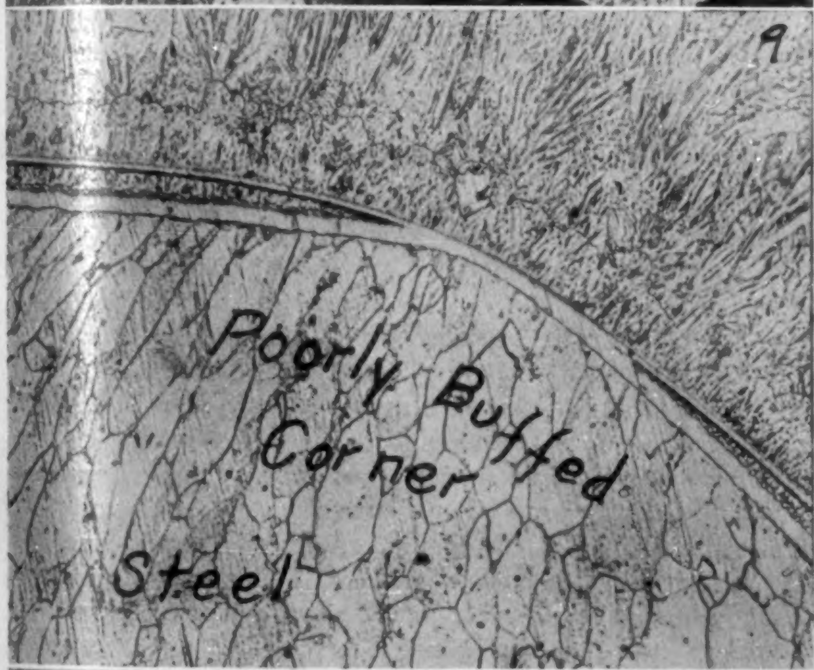
Copper	.00040"
Nickel	.00009"

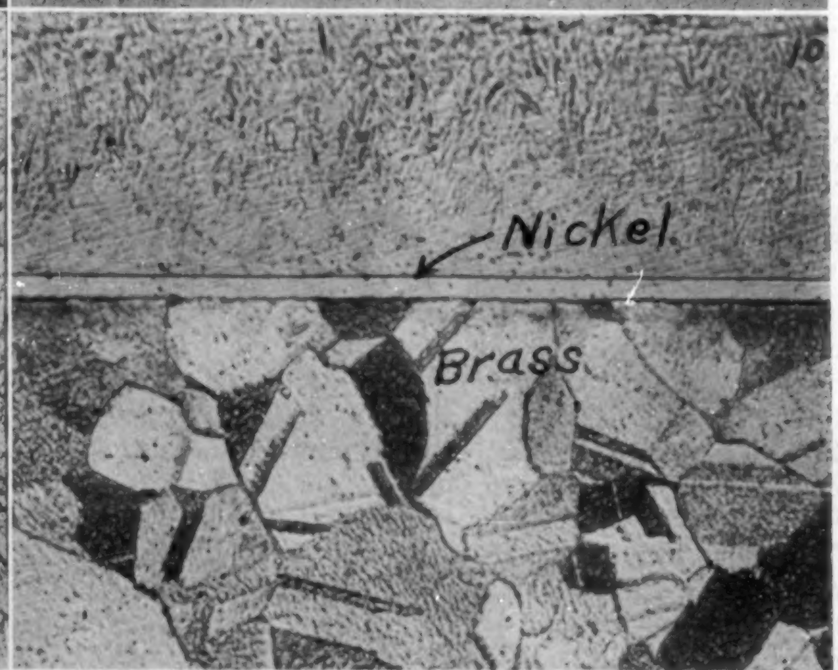
laboratory where such instruments would be available and no additional expense would be incurred.

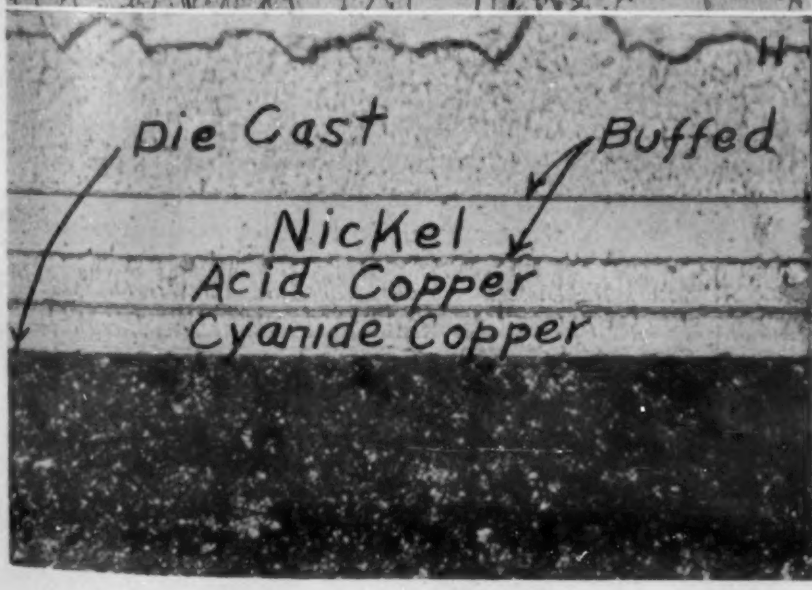
Second, it must be borne in mind that only a small part of the piece is actually measured. However, chemical analyses of plated parts when checked against the microscopic method seldom vary over .0001″ when the total thickness exceeds .0010″. With decreasing amounts of plating the differences will be reduced to as low as .00002″. Careful selection of the location on the plated part from which the specimen is to be cut is also essential in obtaining an accurate measurement. For example, where the piece is small and has sharp edges, the plate thickness may vary considerably from one spot to another. In











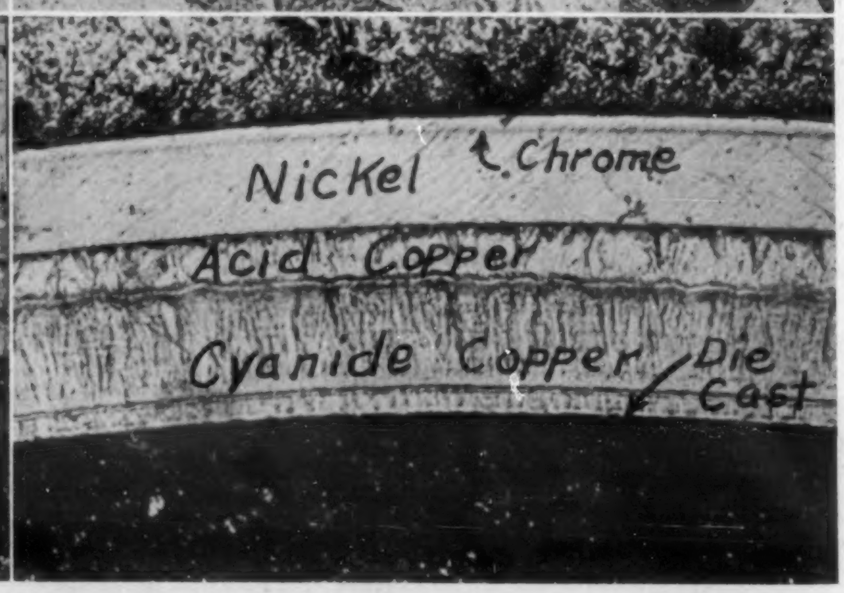


Fig. 7. Nickel Plus Copper Plus Nickel on Steel. Mag. 500x.

1st Nickel	.00025″
Copper	.00050″
2nd Nickel	.00031″

Fig. 8. Well Buffed Corner. Mag. 200x.

Fig. 9. Poorly Buffed Corner. Mag. 200x.

Fig. 10. Nickel on Brass. Mag. 500x.

Nickel	.00019″

Fig. 11. Copper (2 layers) Plus Nickel on Zinc Die Casting. Mag. 500x.

Cyanide Copper	.00043″
Acid Copper	.00040″
Nickel	.00050″

Fig. 12. Copper Plus Nickel Plus Chromium on Zinc Die Casting. Mag. 500x.

Cyanide Copper	.00112″
Acid Copper	.00043″
Nickel	.00078″

this case it is well to take at least 2 measurements, one of the maximum and one of the minimum thickness and to average the results.

One of the greatest advantages in a practical way is the fact that a differentiation between the copper layers is possible, and also in plating where 2 or more nickel layers are used, a rapid measurement of the individual layers is made possible. This gives the production plater an idea which tank is giving the most efficient performance and he is able to adjust his plating time accordingly.

Another advantage is that the quality of the preparation of the base metal can be easily determined and recommendations made to improve the finished part. An examination of the quality of the buffing on the various plates is also possible.

It is not the intention to suggest that the microscopic method of determining plate thickness can be entirely substituted for the chemical method, but merely to show that where speed is essential, the microscopic method can be used to good advantage as a supplementary means.

I wish to express my thanks to D. A. Cotton, W. Castell, G. Cole, and A. Fletcher, all of the Process Department, Delco Remy Corp., for their assistance during the investigation.

EDITORIAL COMMENT

(Continued from page A 19)

The U. S. Joint Research Committee on the Effect of Temperature on the Properties of Metals has a long history of achievement back of it, some of which is sketchily touched upon in a communication from that Committee, printed in last month's issue. But more important than its past record is its plan for the future. Through a special Sub-Committee on Still-Tubes, formed at the request of the petroleum industry, it is planning to secure needed information on the high-temperature behavior of 4 to 6% Cr ½% Mo steel for cracking still tubes, while the main committee has suggested an appraisal of the "short cut" methods for determination of long-time high-temperature properties and their comparison with regular creep methods. The Committee is seeking comment on this program, which we hope our readers will send to Mr. N. L. Mochel, Westinghouse Electric & Manufacturing Company, Lester Station, Philadelphia, Pa.

The plans of the Committee and its sub-committees cover problems that we unhesitatingly classify as not only suitable for, but demanding, joint attack. So many industries need just the information the Committee aims to obtain that, from the point of view of metallurgical engineering, it is not too much to say that coöperation with it deserves to be everybody's business. Because the Committee has already formulated plans and is ready to go forward, the delays incident to usual committee attack would not appear. It can effectively carry on those problems which it has made its particular business. Without such an organization they would be likely to remain "nobody's business."—H. W. GILLETT

Old, But Ever New

WE CRIB the title and the subject from the November, 1933, issue of the Electric Journal, which states that it has so many requests for a discussion of how to run d.c. generators in parallel that it publishes an article containing no new thoughts over one published in 1911 and states further that it also dealt with the subject in 1905, 1909, 1923 and 1926. Despite the existence of lots of published information and the inclusion of the subject in college courses, many engineers in practice still seek reliable information.

The same thing holds in metallurgy. It is not unusual for our abstract pages to contain résumés of several articles by different authors in different languages, each dealing with the same subject and each saying about the same thing. The text of the abstracts might be interchanged. From one point of view it is a waste of paper and ink to print the originals or the abstracts when they all say the same thing.

On closer examination, there will be found reasons for the apparent duplication. Such articles often appear in engineering journals devoted to a special field and serve to acquaint users of metals with points that they may not be up on, and so serve a highly useful purpose.

In strictly metallurgical journals the same subject recurs at intervals, some times as rehash or "state of the art" articles without new information or points of view, with the main advantage to one who already knows the field depending on clarity of expression and logical arrangement which may render it easier for him to remember and use the facts. To the youngster just entering the field, however, such an article, expanding and driving home more clearly something he may know only in vague outline, may be priceless.

Those in between in knowledge and experience may be benefited by repetition and review, for one seldom grasps an idea completely on its first presentation. Repetition clinches the impression, just as in advertising.

That reiteration brings acceptance is fine if what is reiterated is true, but not so good if it be only half truth or actual falsity. Truth may best be judged by the experimental engineering data recorded, i.e., by the inherent evidence, so editorial pressure for condensation should leave enough of such proof in to carry conviction. Creditability is also established by the experience and standing of the author and by his impartial position when he has no possible axe to grind. Personally, we are seldom impressed by inspired press releases stating that this or that has been accomplished in the metallurgical field. They may have news value, but we hesitate to add *Metals & Alloys* to the list of journals carrying such items unless and until technical evidence that will convince the interested engineer from Missouri is forthcoming. Our readers demand something more than assertion. We believe, too, that advertising addressed to production and operating men today is most effective when it contains engineering proof of the assertions made.

So when engineers in different countries state the same things, it probably means that the things they state are really true. The reader who goes over the abstracts from that point of view may find more information in them than at first meets the eye. If there is general agreement abroad on items that have not yet been given much thought in this country, it is likely that more thought would be justified here.

For example, the abstracts for the last year or so indicate that rotating powdered coal melting furnaces and low alloy chromium-copper steels are very live subjects abroad. These and similar subjects are, in a way, old, but till they have been adequately explored in relation to our own problems, they still remain new.—H. W. GILLETT

PROPERTIES OF METALS (1)

New Phenomena in the Change of Resistance of Bismuth Single Crystals in Magnetic Fields. O. Stierstadt. *Physical Review*, Vol. 43, Apr. 1933, pages 577-579. Bi shows the greatest change of resistance of all metals of electrical conductivity in a magnetic field. These changes in conductivity are strongly dependent upon the orientation of the crystal and upon the direction of the crystal axes with respect to the directions of the field and the current. It has been possible for the first time by means of a specially constructed crystalgoniometer to investigate the conductivity of a metal crystal in every desired configuration of current, field and crystal axes. It is shown that most of the important crystal planes influence the resistance change in some characteristic fashion. This is true of all the planes which are necessary for the description of the elementary cell of Bi lattice. Direct electric or magnetic measurements do not discriminate these planes. This type of crystal analysis is not as useful as the optical methods but is useful where optical methods are not applicable, especially in detecting structure elements. WAT (1)

On the Electric Resistance of Magnesium and Its Alloys. K. Takahashi & W. Eda. *Kinzoku no Kenkyu*, Japan, Vol. 10, Apr. 1933, pages 127-136. The specific electrical resistivity of pure Mg and its alloys with Al, Zn, Cd, Ag, Cu and Ni has been measured. The effect of Al is largest; 8% Al added to pure Mg increases the resistivity from 4 to 14 ohm-^{6}/cc. The addition of Cu increases the resistivity very slightly. The order is Al, Sn, Zn, Ag, Cd, Ni, Cu. The element which forms solid solution with Mg increases the resistivity greatly as in the case of Al; but the element which forms a eutectic with Mg increases the resistivity slightly as in the case of Cu or Ni. KT (1)

Sensitivity of Steel and Modern Idea of Quality. H. W. Graham. *Iron Age*, Vol. 129, June 2, 1932, page 1211, adv. sec. page 20; *Steel*, Vol. 90, May 23, 1932, pages 28-29. Includes discussion. Abstract of paper read before the American Iron & Steel Institute in New York. See *Metals & Alloys*, Vol. 4, July 1933, page MA 205. JN + VSP (1)

Magnetism of Metallic Elements (Der Magnetismus der metallischen Elemente) E. Vogt. *Ergebnisse der exakten Naturwissenschaften*, Vol. 11, 1932, pages 323-351. Literature survey. 59 references. WH (1)

Nickel and Its Uses. Robert C. Stanley. *Chemical Engineering & Mining Review*, Vol. 25, June 5, 1933, pages 291-292. An abstract of an address dealing with pure Ni, ferrous and non-ferrous alloys containing Ni. WHB (1)

Elasticity of Copper Sheet (Elastizität von Kupferblechen) J. Weerts. *Zeitschrift für Metallkunde*, Vol. 25, May 1933, pages 101-103. The known anisotropy of single crystals of Cu with respect to the elastic moduli in tension (E) and in shear (G) is used for the calculation of these moduli in cold-rolled (96% reduction in thickness) and recrystallized (heated to 500° C.) Cu sheet upon the basis of determined preferred orientations. The two types of preferred orientation systems found in cold-rolled Cu are assumed to be present in equal amounts; the single system in recrystallized Cu requires no such assumption. The moduli (only in the rolling plane) were measured in eight strips at varying angles in one quadrant. In cold rolled sheet the minimum value for E was found at 45° to the rolling direction, 15,500 lbs./in.^{2} in comparison to a calculated value of 13,500 lbs./in.^{2}, and the maximum value parallel to the rolling and to the cross directions (which give identical values), 20,000 lbs./in.^{2} in comparison to a calculated value of 22,500 lbs./in.^{2} In recrystallized sheet the maximum value of E was found to lie at 45° to the rolling direction, 17,500 lbs./in.^{2} as against 19,000 lbs./in.^{2} calculated, and the minimum value in the rolling and cross directions, 9,800 lbs./in.^{2} as against 9,700 lbs./in.^{2} The calculated values for elastic anisotropy are thus very close to the determined values. This article includes a bibliography on this recently developed research field. RFM (1)

Diffusion in Metals (Diffusion in Metallen) Chr. Specht. *Die Metallbörse*, Vol. 23, Apr. 8, 1933, page 447; Apr. 22, 1933, pages 509-510; Apr. 29, 1933, page 542. It is highly indicative that purely chemical reactions take place in several stages, the first of which represents a diffusion. If mono-molecular films are involved it does not matter whether we are dealing with the solid, liquid or gaseous state. The most outstanding investigations into the H absorption in Fe are summarized. No diffusion takes place in Schoop's coating process based on "atomizing" spray. Only those metals diffuse in Fe which form solid solutions with the latter. C retards diffusion in Fe. Cr readily migrates into it. Fe in contact with a mixture of 50/50 Cr-Ni powder shows a higher diffusion rate of Ni although the contrary should be expected in view of tests with the individual metals. Exceedingly low diffusion into Fe was noticed with Ni-Al powder while occurrence of Al_2O_3 checked the diffusion of Cr in a Cr-Al mixture. Exposing a soft and hard steel in vacuo to 950° C. for 4 days showed that the soft steel gained 0.4% C while the hard one lost 0.5% C. Since there was no direct contact, a transfer through the gas phase must have taken place. The cementation of Fe by foreign metals which principally takes the same course as the cementation by means of C, can be utilized for the preparation of noble surfaces of special scaling or corrosion properties. 18 references. EF (1)

Condition Affecting the Freezing Temperature of Silver. William F. Roeser & A. I. Dahl. *Bureau of Standards Journal of Research*, Vol. 10, May 1933, pages 661-668. Study was made of the precautions which should be observed in using the freezing point of Ag as a thermometric fixed point. Observations were made on 3 samples of Ag containing various amounts of impurities. The depression of the freezing point due to absorption of O was measured under a number of conditions. It was found that graphite crucibles and covers were as effective in protecting Ag from O as a vacuum 0.005-0.03 mm. of Hg. WAT (1)

The Lowest Valencies of Rhenium and Ruthenium: Tri-valent Rhenium and mono-valent Ruthenium (Ueber die niedrigsten Wertigkeitsstufen von Rhenium und Ruthenium: dreiwertiges Rhenium und einwertiges Ruthenium) W. Manchot & J. Duesing. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 212, May 1933, pages 21-31. The production of 3-valent Re and 1-valent Ru is described. The investigation of the relations between Fe and Ru make it very probable that also Fe can exist in mono-valent compounds. 17 references. Ha (1)

Novel Photo-Electric Experiment (Über einen neuen photoelektrischen Versuch) Q. Majorana. *Physikalische Zeitschrift*, Vol. 33, Dec. 1, 1932, pages 947-952. Metal films of Ag, Au, Pt, Sn, Al and Zn showed an increase of electric resistance when exposed to a pulsating radiation. EF (1)

Beryllium (Le Glucinium) J. Laissus & P. Tyvaert. *Bulletin de l'Association Technique de Fonderie*, Vol. 7, June 1933, pages 209-219. Its history, occurrence, reduction, principal properties, metallic alloys, and economic situation. Its principal alloys are Fe Be, Fe Ni Be, Cu Be and Ni Be. Light metal alloys with Be are not important. Age hardening is one of the important properties of Be alloys. WHS (1)

The Magnetic Susceptibilities of Lead, Silver and Their Alloys. Carol G. Montgomery & William H. Ross. *Physical Review*, Vol. 43, Mar. 1933, pages 358-360. Magnetic susceptibilities of Pb, Ag and their alloys have been determined by a modified Curie balance. Results previously reported by Spencer and John in regard to the magnetic behavior of these alloys are not confirmed. WAT (1)

Non-Conducting Metal Modifications (Nichtleitende Metallmodifikationen) J. Kramer & H. Zahn. *Die Naturwissenschaften*, Vol. 20, Oct. 21, 1932, page 792. By cathode atomization and evaporation, thin metallic layers can be secured the conductivity of which is very low as compared with the regular metals. EF (1)

On "Matthiessen's Constant," or the Relation Between Electrical Resistivity and Temperature Coefficient of Metals. J. T. MacGregor-Morris & R. P. Hunt. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Vol. 14, Sept. 1932, pages 372-383. A study of accuracy of Matthiessen's constant. It does not hold true for eutectic mixtures. By its use one is able to predict rapidly resistivity of a sample of commercially pure metal. 15 references. RHP (1)

German Standardization of Rare Metals. (Die deutsche Normung der Edelmetalle.) H. Moser. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle*, Vol. 6, Dec. 1932/Jan. 1933, pages 99-105. Suggested standards for pure and alloyed Ag, Au and Pt are tabulated giving required degree of purity for definite purposes, trade names, shapes available (wire, sheet, bars, etc.), and admissible margins. In list for Pt, Pt alloys with Ir from 1 to 30% are given. Ha (1)

The Photoelectric Properties of Films of Beryllium, Aluminum, Magnesium, and Thallium. H. de Laszlo. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Ser. 7, Vol. 13, June 1932, pages 1171-1178. Opaque films formed by evaporation of above metals in high vacuum on to a previously degassed surface were examined with respect to their photo-electric properties in monochromatic light. Measurements were made between 25000 and 2400 A.U., and photoelectric response in coulombs per erg as well as in electrons per quantum was plotted against wave length. Mg gives suitable surface to use in the construction of photoelectric cells for measurement in ultra violet. Be and Al are of low efficiency. Mg-Li alloys indicate possibility of constructing cells having any desired spectral sensitivity distribution. 10 references. RHP (1)

On Certain Variations in the Optical Constants of Copper. H. Lowery & R. L. Moore. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Vol. 13, May 1932, pages 938-952. Gives a brief survey of methods of determining optical constants of metals and discrepancies between results of various observers using polarimetric methods are discussed. Suggests that Beilby theory of polish may offer an explanation of divergencies. Optical constants of a piece of Cu are measured using varying degrees of surface strain. Results indicate that a heavy polish increases refractive index and decreases absorption and reflection coefficients. Deterioration of a Cu mirror to learn most satisfactory condition for measurement of the dispersion curve. 27 references. RHP (1)

Electric Supra-Conduction in Metals. J. C. McLennan. *Nature*, Vol. 130, Dec. 10, 1932, pages 879-886. Besides Hg and Pb the following metals and some of their alloys and chemical compounds exhibit the supra-conductive property if made sufficiently cold: Sn, In, Ga, Tl, Ta, Ti, Th, and Nb. The application of mechanical stresses raises the transition temperature of a supra-conducting metal, while the application of a magnetic field delays the appearance of supra-conductivity. Results of experiments with high-frequency a.c. seem to justify the conclusion that a polarization or orientation phenomenon of some kind must be involved in the production of the supra-conducting state. It is suggested that the conducting electrons in metals may build a lattice. Thus the transition point or temperature at which the metal passes from the supra-conductive state to the ordinary conducting one may be interpreted as the melting point of the electron lattice. Kz (1)

Isotopes of Uranium, Thorium and Lead, and Their Geophysical Significance. Charles Snowden Piggot. *Physical Review*, Vol. 43, Jan. 1933, pages 51-59. In an effort to improve the data in the calculation of geologic age a determination of the isotopes of the elements involved in the radioactive disintegrations was made by the magneto-optic technique of Allison. There appear to be 4 radioactive series beginning with 8 isotopes of U (2 to each) and ending with 16 isotopes of Pb (4 to each). The relations of the constituent isotopes of U to those of Pb in a mineral are complex, and vary somewhat from mineral to mineral. Ordinary Pb and radioderived Pb possess different isotopic compositions though both apparently derive from same ultimate source. The isotopic composition of Pb changes with age. WAT (1)

Note on Tungsten Crystals. O. L. Ochse. *Journal Chemical, Metallurgical & Mining Society of South Africa*, Vol. 33, May 1933, page 336. A deposit on the inside of a light bulb consisted of W octahedra. AHE (1)

Weight of Pure Nickel Sheet—Hot or Cold Rolled. J. K. Olsen. *Metal Stampings*, Vol. 5, Feb. 1932, page 138. Tabulates thicknesses in in. and weights in lb./ft.^{2} for U. S. standard gage numbers. MS (1)

Tensile Tests with Copper-Nickel Crystals (Zugversuche an Kupfernickelkristallen) E. Osswald. *Zeitschrift für Physik*, Vol. 83, June 6, 1933, pages 55-78. A special method for producing the pure monocrystals and alloy monocrystals was developed. The Cu crystals showed, contrary to the Ni crystals, no pronounced elastic limit. The curve representing the elastic limits of the monocrystals of Cu-Ni alloys is very asymmetric, the elastic limits on the Ni end being much higher than on the Cu end. Ni is therefore exceptional as compared with Cu, Au and Ag. The gliding mechanism of the crystals was found to be the same as all other crystals of the same lattice type. Ha (1)

Rhenium. (Das Rhenium.) Ida and Walter Noddack. Leopold Voss Verlag, Leipzig, 1933. Paper 6¼ x 9¼ inches, 86 pages. Price 7.80 RM. The authors of this monograph first announced the discovery of rhenium in 1925. After examining 1800 minerals and struggling for several years to produce the first samples of this new element in mg. lots it was found possible in 1930 to recover 120 kg. annually as a by-product from one of the German chemical works. This good fortune suddenly reduced the market price from 50,000 to 13 marks per g.; it put rhenium in the unique position of being one of the rarest stable elements and yet within the reach of all. During the past two years numerous investigators have been studying its properties and seeking technical applications so that more is now known about rhenium than about some of the other elements discovered many years earlier. As authors of this monograph the discoverers have given in a dozen short chapters an orderly and critical summary of the present knowledge concerning rhenium. The first 3 chapters outline the history, occurrence and extraction of the element, the 4th deals with the metal, and the 5th with analytical tests and quantitative determinations. The remaining chapters summarize the preparation and description of rhenium compounds, beginning with 7-valent rhenium which is the most characteristic valence, and ending with univalent-rhenium compounds. The occurrence of 7 different valence values and the easy substitution of sulphur or halogens for oxygen in rhenium compounds leads to a very complex rhenium chemistry. A great number of rhenium compounds has already been prepared and studied so it is not surprising that nearly half of the monograph is devoted to this subject. A bibliography of 150 literature references (1925 to March 1933) appears at the end of the monograph. No claims to completeness in this respect are made (although perhaps implied) but if the spectroscopic omissions are representative every one will hope that a more extensive bibliography will accompany the second edition. Indeed the only misinformation detected by the present reviewer can be ascribed to faulty bibliography. For instance a statement is quoted that "in the spectrum of the sun lines are found which have the same wave length as some of the strongest optical Re lines so that the presence of the element in the sun is probable," but a more careful analysis showing that there is no spectroscopic evidence for Re in the sun is overlooked. Despite these minor defects, and some harmless typographical errors, the monograph will be of great interest to all scientific and technical workers. Those who have not had an opportunity to follow the rapid developments will appreciate this introduction to the newest member of the chemical family, while chemists, physicists and metallurgists will recognize the usefulness of this compilation of facts concerning a most interesting element and a metal with possibly unusual technical applications. William F. Meggers (1) -B-

PROPERTIES OF NON-FERROUS ALLOYS (2)

Properties of the Alloys of Nickel with Tantalum. ERIC THERKELSEN. *Metals & Alloys*, Vol. 4, July 1933, pages 105-108. 19 references. An investigation of Ni-Ta alloys shows they form a series of solid solutions between 0 and about 36% Ta and form at least 1 compound, Ni_3Ta. The liquidus temperatures of the alloys between 0 and 36% Ta lie below that of pure Ni. Ni_3Ta melts at a maximum point on the liquidus. All solid solution alloys are malleable with strength and hardness increasing with Ta. A 36-37% improvable Ta alloy is possible. 13 micrographs show structure with increasing Ta content. The Ni-Ta constitution diagram, curves of physical properties, thermal e.m.f of Ni-Ta couples and corrosion data are given. WLC (2)

Casting Temperatures and Physical Properties of Aluminum Alloys (Giesstemperaturen und mechanische Eigenschaften der Aluminiumlegierungen) R. THEWS. *Die Metallbörse*, Vol. 22, July 2, 1932, pages 834-835; July 9, 1932, pages 866-867. Casting Al alloys at too high and at too low temperatures results in a loss of physical properties. Tests of the writer yielded that short superheating to 900° C. and immediate cooling down to 680° C. by adding solid metal did not materially affect the physical properties of the cast alloys. The time of superheating is the essential criterion. A gradual loss in tensile strength from 14 kg./mm.² at 650° C. pouring temperature to 11.2 kg./mm.² at 870° was reported in 1912 by H. W. Gillett. The effect of casting temperature on tensile strength for some 50 sand cast Al alloys is tabulated. The influence of the casting temperature was also noticed in die casting. (Rosenhain-Lantsberry.) Recent investigations, which are fully reviewed, confirmed that all physical properties of Al alloys are impaired by rising casting temperatures. EF (2)

The Bronzes. F. C. THOMPSON. *Tin*, Nov. 1932, pages 12-14. Bronzes combine high tensile strength, high elastic limit, ductility and toughness with good castability, hot and cold working. The pouring temperature must however be carefully controlled. With higher percentages of Sn the alloy becomes harder and the cold-working properties disappear. Wear resistance of moving parts and corrosion resistance make this alloy of particular use. A general review of some compositions is given. Ha (2)

Mechanical Properties of White-Metal Bearing Alloys at Different Temperatures. H. K. HERSCHMAN & J. L. BASIL. *American Metal Market*, Vol. 39, July 27, 1932, pages 3-7, 10. See *Metals & Alloys*, Vol. 4, Sept. 1933, page MA 276. DTR (2)

Factors Affecting the Physical Properties of Cast Red Brass. H. B. GARDNER & C. M. SAEGER, JR. *American Metal Market*, Vol. 39, Aug. 4, 1932, pages 4, 12. See *Metals & Alloys*, Vol. 4, Sept. 1933, page MA 276. DTR (2)

The Influence of Design on Brass and Bronze Castings. LEWIS H. FAWCETT. *Foundry Trade Journal*, Vol. 47, Aug. 25, 1932, pages 111-113; *Foundry*, Vol. 60, June 1932, pages 22-25, 61-62. See *Metals & Alloys*, Vol. 4, Sept. 1933, page MA 276. OWE + VSP (2)

Precious Alloys of Gold and Silver with Nickel (Les Alliages Précieux d'Or et d'Argent et de Nickel) F. RENAUD. *Bulletin de l'Association Technique de Fonderie*, Vol. 16, Sept. 1932, pages 444-448. Paper at World Foundry Congress, Paris, Sept. 1932. The production of white gold by means of Ni in place of palladium or platinum. The heat treatment of such an alloy at low temperatures for different colors, chemical and physical properties is given. Alloys of Ni and Ag for coinage. 7 references. WHS (2)

Centrifugal Bronze Gear Blanks. FRANCIS W. ROWE. *Metal Progress*, Vol. 23, June 1933, pages 15-19. In England Al Bronze has been used for worm wheels of light trucks, but use is limited to light surface stress jobs. P bronze, of 10 to 12.5% Sn, Pb 0.50 max., Zn 0.50 max., P 0.2 to 0.4%, Ni 0.0 to 0.2%, is used for heavy jobs. Sn above 10% decreases tensile and shock strengths, and ductility. The same applies to P. The Cu_3P formed is associated with alpha-delta eutectoid and is a powerful hardener. 2 micrographs show these constituents. Pb above 0.50 lowers yield point in compression, increasing the tendency to pitting. Ni additions overcome these defects and raise tensile and impact values. Ni must be carefully controlled to prevent too low plasticity. A table of physical properties shows the influence of size and casting process. Low density and variable properties of sand cast blanks preclude their use for gears. Ring chilling improves these castings, but gives a chilled portion deficient in alpha-delta eutectoid. 3 sided chilled blanks, a commonly used method, improves results, but high liquid shrinkage brings large grain size and other difficulties. The centrifugal process does away with these defects and the use of risers. Constant agitation during solidification gives small grain size with short dendrites. The high and uniform density gives a strong structure. Metal is cast through a sand core at peripheral speed of 1600 ft. per min. for 8 to 10 in. diameter blanks, to 2400 ft. per min. for 5 to 6 ft. blanks. Macrographs show the structure obtained with the 4 methods of casting. Mass of casting makes small difference in physical properties where the centrifugal process is used. WLC (2)

Physical and Mechanical Properties of Mg-Al-Cu Alloys Rich in Mg (Contribution à l'etude des propriétés physiques et mécaniques des alliages magnésium-aluminium-cuivre, riches en magnésium) A. PORTEVIN & P. BASTIEN. *Comptes Rendus*, Vol. 196, Mar. 6, 1933, pages 693-696. Continues work previously reported by these authors (*Comptes Rendus*, Vol. 195, 1932, page 441). Diagrams show surfaces representing the hardness and electrical resistance of the alloys. The effects of variable compositions on the coefficient of thermal expansion and on elastic properties are briefly indicated in connection with the equilibrium diagram. OWE (2)

Common High Brass. R. S. PRATT. *Metal Progress*, Vol. 24, Aug. 1933, pages 39-40, 50-52. Physical properties of the well known 64-36 Cu-Zn alloy are discussed as related to annealing temperatures, grain size, and reduction by drawing. These relations are shown graphically. The effect of Pb upon the physical properties and machining qualities are described. The uses, corrosion resistance and specification for this class of material are discussed. WLC (2)

Alloys for Pressure Die-casting. P. MABB. *Machinery*, London, Vol. 39, Mar. 17, 1932, pages 781-782. Pressure die-castings are rapidly becoming recognized as a substitute for accurately machined castings and possess advantages which are enumerated. They are ordinarily produced from one of 4 groups of alloys the basic metal of which is respectively Al, Zn, Sn and Pb. Characteristics which the alloys, selected for certain kinds of service must possess, are discussed and changes in structure of alloys during manufacturing process are dealt with. Alloying constituents of Al-base die-castings are Cu, Zn, Mg, Si, Ni, Fe and influence of these metals added in various percentages to alloy are summarized. Zn-base alloys contain Al, Cu, Mg, Pb, Cd and Sn to render them suitable for service desired. Third group discussed are alloys with a base of Sn or Pb with Cu and Sb as additions. Composition and physical properties of each group are presented in tables. Kz (2)

Technical Properties of Beryllium Containing Cu-Ni Alloys (Technische Eigenschaften der Be-haltigen Cu-Ni-Legierungen) G. MASING & W. POCHER. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 11, July 8, 1932, pages 93-98. Cu-Ni alloys with additions of Be can be hardened to a considerably higher degree, above 300 Brinell, with much less Be than is possible in the binary Cu alloys. The alloy of 39% Cu, 60% Ni, 1% Be showed in the refined state a tensile strength of 115 kg./mm.²; 19% Cu, 80% Ni, 1% Be showed 100 kg./mm.² with an elongation as high as 13%. These values were retained up to 400° or 450° C., while binary alloys lose their tensile strength at a much lower temperature. A list of a great number of Cu-Ni alloys with different amounts of Be is given with their hardness and tensile properties at different heat treatments. Ha (2)

PROPERTIES OF FERROUS ALLOYS (3)

The Character of Cast Iron. A. C. VIVIAN. *Mechanical World & Engineering Record*, Vol. 92, Dec. 30, 1932, pages 621-622. The stress-strain curves have generally been considered as consisting of an elastic stage followed by a plastic one. Author suggests that the strain included in a material consists at any stage of 2 components—one elastic and dependent on the magnitude of the stress, and the other plastic and dependent not only on the magnitude of the stress, but also on the length of time during which the load is applied. Author has concluded from his studies that cast iron provides an example of an elastic material which does not obey Hooke's law, but which is entirely rational in its behavior. Cast iron has a character which is essentially different from steel, and the author is of the opinion that more use might be made of cast iron if its character were closely investigated on lines suggested. Kz (3)

Heat-Treated Alloy Cast Iron. *Foundry Trade Journal*, Vol. 47, Oct. 6, 1932, page 203. A summary of development by Bullard Co., Bridgeport, Conn., of special alloy cast irons and steels for machine-tool parts. The most important development is that of a Ni-Cr cast Fe which undergoes special heat treatment. OWE (3)

Molybdenum Additions Broaden Cast Iron's Sphere of Automotive Usefulness. *Automotive Industries*, Vol. 68, May 20, 1933, pages 618-620. Summary of recent research and progress in use of this important new alloy iron. This article is a review of the 1933 Supplement to the original paper on Molybdenum in Cast Iron. as published by the Climax Molybdenum Co., N. Y. DTR (3)

The Manufacture and Physical Properties of Nickel-Copper-Chromium Austenitic Cast Irons. *Foundry Trade Journal*, Vol. 48, May 18, 1933, pages 347-348, 354. Deals especially with those Ni-Cu-Cr austenitic cast irons known as "Ni-Resist." The range of compositions generally used and methods of manufacture from Ni-Cu-Cr pig are summarized; most favorable conditions for adjustment of composition in some constituents (e.g., Cr and Mn) are given. Casting allowances, pouring temperatures, molding sands, and use of chaplets of Monel metal are briefly mentioned. Easy machinability and welding of these alloys are useful features. A few physical properties and uses are given, and a series of practical suggestions are appended. OWE (3)

A Résumé of the Work of the Malleable Iron Sub-Committee of the Institute of British Foundrymen. *Foundry Trade Journal*, Vol. 47, July 21, 1932, pages 31-33; July 28, 1932, pages 47-51. Specifications of most convenient test-bars are summarized, and 5 photographs show the relative advantages and disadvantages of various types. A graph is given showing relation between diameter of bar and tensile strength of black-heart cast iron. 2 graphs show the magnetic properties of malleable iron. Results on malleable test bars show the disadvantages of machining after annealing in case of white-heart. Main advantage of machining before annealing is to obtain bars of a uniform size, machining having no effect on the subsequent annealing. A considerable amount of work on the connection between microstructure and other properties is summarized. A standard method for preparing, feeding, and annealing was developed. The relationship of strength to composition is shown graphically (6 figs.) in so far as C, Si, Mn and S are concerned. The microscopical examination (10 photographs) is also standardized, and an outline of the suggested procedure is given. OWE (3)

Highly Magnetic Alloys of Nickel-Iron. (Hochmagnetische Legierungen aus Nickeleisen.) GEO. KEINATH. *Archiv für technisches Messen*, Vol. 2, Nov. 1932, Section Z 913-3, page T 173. Most recent developments are alloys of carbonyl-Fe and carbonyl-Ni; a 50-50 alloy has a maximum permeability of 56000 at only 0.05 oersted; the specific resistance is 0.41. A few ternary alloys with Mo and Cr show increased initial permeability and reduced sensitivity against mechanical and thermal abuse. Comparative curves of Ni-Fe-Mn alloys, carbonyl alloys and formerly known materials are reproduced. See also *Metals & Alloys*, Vol. 3, May 1932, page MA 117. 9 references. Ha (3)

Alloy Cast Iron Developed for Machine Tool Parts. EDWIN F. CONE. *Iron Age*, Vol. 130, Aug. 4, 1932, page 183, adv. sec. page 16. Describes an Ni-Cr-Fe developed by Bullard Co. Average composition is:

	Per cent		Per cent
Total carbon	2.75 to 3.00	Nickel	1.50 to 1.75
Silicon	2.40 to 2.70	Chromium	0.30 to 0.50
Manganese	0.70 to 1.00	Sulphur & phosphorus	0.100 max.

This alloy may be suitably heat treated to meet requirements. There is a marked difference in physical properties of this alloy Fe as cast and after heat treatment. To raise its tensile strength it is quenched. Tempering is done at 850° to 950° F. to give a Brinell hardness of 286 to 340. Selection of quenching medium is governed by size of section being heat treated. Average tensile strength of heat treated Fe is 70,000 to 75,000 lbs./in.². Feature of metal is its machinability at Brinell hardness of 340. VSP (3)

Nickel Steel Castings. (Les moulages d'acier au nickel.) M. COMBE. *Aciers Spéciaux, Métaux et Alliages*, Vol. 8, Mar. 1933, pages 70-79. 18 references. Critical review of existing knowledge on alloy steel castings. C steel, Ni, Ni-Cr, and Ni-Cr-Mo steels are discussed in detail and their physical properties generally compared. GTM (3)

Study of Natural Titanium-Vanadium Cast Irons. (Étude des Fontes Naturelles au Titane-Vanadium.) JEAN CHALLONSONNET. *Bulletin de l'Association Technique de Fonderie*, Vol. 16, Sept. 1932, pages 524-535. Paper at World Foundry Congress, Paris, Sept. 1932. V in cast Fe gives increased strength and hardness. Carbides or troosto-sorbitic pearlite may be produced, depending on other constituents of Fe. Addition of Ti moderates chilling effect of V. Use of Ti-V bearing pig Fe in mixture gives cheapest and best results. Castings from such a mixture have fine graphite, improved physical properties and are easily machinable. 12 references. WHS (3)

Corrosion-Resisting Steels—Their Structure and Characteristics. C. M. CARMICHAEL & G. S. SHAW. *Iron & Steel of Canada*, Vol. 16, Feb. 1933, pages 23-28. Summarizes main causes of failure in stainless steel under headings of incorrect composition, improper heat-treatment, and electrolytic action. Experiences with welding, punching, drilling, etc. are given. 13 photographs, of which 11 are photomicrographs showing corrosion, welding and effect of heat-treatment. OWE (3)

The Density of Ferrosilicon. (Sur la densité des ferrosiliciums.) CH. BEDEL. *Journal du Four Electrique*, Vol. 41, Nov. 1932, page 419. See *Metals & Alloys*, Vol. 4, Aug. 1933, page MA 242. JDG (3)

Mechanism of Deformations in Grey Iron. J. W. BOLTON. *Foundry Trade Journal*, Vol. 47, Sept. 1, 1932, pages 125-126. See *Metals & Alloys*, Vol. 4, May 1933, page MA 136. OWE (3)

Automobile and Aircraft Steels. (Stalen voor automobielen en vliegtuigen.) *Polytechnisch Weekblad*, Vol. 26, Feb. 11, 1932, pages 92-93. In table I some 18 chemical analyses of Ni, NiCr, CrSi, Cr, CrMo, CrNiW, CrW, and CrNiSi steels are compiled while a second table gives the composition of 17 structural steels, their thermal treatment and 7 of the more important physical properties. WH (3)

Pearlitic Cast Iron. (Nieuwere inzichten over perlitisch gietijzer.) *Polytechnisch Weekblad*, Vol. 26, Aug. 25, 1932, pages 537-538. Discussion on "Edelguss," i.e. a cast iron with perfect pearlitic structure and extremely fine graphite distribution, free from contaminations, very low in phosphide and sulphide inclusions, of following analysis: 3% C, 2% Si, 0.8% Mn and about 0.2% P. The modifications of the analysis and effect of elements present are considered besides physical properties, application and making of this special cast iron. WH (3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION (4)

The Influence of Oil in Soil Corrosion. W. F. Rogers. *Oil Weekly*, Vol. 68, Feb. 13, 1933, pages 12-16. Paper read before the Committee on Corrosion 1 of the American Petroleum Institute, at the Annual Meeting, Houston, Nov. 15, 1932. Crude oils and refined petroleum products have been used under certain conditions to protect metals from corrosion. It was assumed that oil which leaked into the ground and would find its way to the pipe surface would be protective. The presence of oil in soils has been found to materially accelerate the rate of soil corrosion. Soils which would normally allow a pipe life of 20 to 30 years may become so changed that the pipe will become penetrated in 5 to 6 years. The action of oil in accelerating the soil corrosion rate varies both with the type of soil and the quantity of oil present, although the minimum concentration necessary for corrosion to be accelerated has not been determined. Kz (4)

Scaling of Higher Silicon Transformer Sheet. (Die Zunderbildung auf Dynamoblechen 2 **mit höherem Siliziumgehalt.)** H. Fromm. *Stahl und Eisen*, Vol. 53, Mar. 30, 1933, pages 326-328. On final annealing 1.8% Si transformer sheet a yellowish-green to dark-brown coating forms, the so-called silicon scale. This may be avoided by pickling before the final anneal. The scale becomes considerably thinner on heating in hydrogen but is not diminished by cooling in producer gas. SE (4)

The Action of Sulfuric Acid and Hydrochloric Acid on Mild Steel. Harold Edwards. *Industrial Chemist*, Vol. 9, Mar. 1933, pages 79-82. A brief review of previous work is given. 9 references. The author gives the results of some experimental work in an attempt to show the influence of: (1) heat treatment of the steel, (2) chemical composition of the steel, (3) concentration and temperature of the acid, (4) concentration of the iron salts in the acid and (5) agitation 3 of the acid. Some work was also done to determine the influence of inhibitors. RAW (4)

A Sensitive Method of Measuring Corrosion. W. E. Campbell. *Bell Laboratories Record*, Vol. 11, July 1933, pages 333-338. Beginning was an investigation into corrosion of lead sheath in presence of vapors from wood. Ordinary accelerated corrosion tests not suitable. Method devised depends on reduction of cross-section and consequent increase in electrical resistance of strips (wires in some cases) mounted on insulating supports in upper part of glass jars, bottom of which contained sawdust from woods under investigation. Method later modified for other corrosion measurement problems: (1) effects of insulating materials in contact with metals subjected to voltage in humid atmosphere; (2) corrosiveness of oils; (3) 4 corrosiveness of non-aqueous solvents. In all cases, jars were placed in thermostat-controlled enclosures. Tests gave results pointing way to remedial measures which proved successful. MFB (4)

Stable Steels in Chemical Industry. (Les aciers inoxydables et inattaquables dans les industries chimiques.) P. Deturmeny. *La Revue de Chimie Industrielle*, Vol. 41, Mar. 1932, pages 71-76; Apr. 1932, pages 101-104. History of stainless Ni and Cr steels is traced back to 1821 and 1913 respectively. The martensitic and austenitic corrosion resistant steels are dealt with and attention is directed toward non-oxidizing, non-ferrous materials of Cu-Ni base. The working properties of Cr-Ni, Cr-Ni-Mo, Cr-Ni-W and Cr-Ni-Si steels are summarized and their chemical resistance against various corrosive reagents and the underlying facts 5 responsible for the marked corrosion stability are pointed out. WH (4)

Corrosion and Cracking in Boiler Plates. J. W. Donaldson. *Metallurgia*, Vol. 8, July 1933, pages 87-88; Aug. 1933, pages 121-122. Reviews literature. JLG (4)

Corrosion of Magnesium Alloys (Korrosion von Magnesiumlegierungen) W. Kroenig & G. Kostylev. *Zeitschrift für Metallkunde*, Vol. 25, June 1933, pages 144-145. Sheet samples of Mg (0.03% Al, 0.04% Fe, 0.02% Si) were wired to similar plates of other metals (Pt, Al, Fe, Ni, Cu, Pb, Mn, Zn, Hg) and immersed in a solution of 3% NaCl in water. A table is given, showing quantities of H developed at each electrode and the current strength; the quantity of H developed is corrected by the amount of H developed on a single control Mg plate. The electrical connection with other metals increases H evolution on 6 the Mg anode. The amount of H developed at both Mg and the second electrode depends upon the nature of the cathode metal and increases with increasing hydrogen overvoltage of the cathode. RFM (4)

Fighting Corrosion in Bridge Maintenance. W. R. Roof. *Railway Engineering & Maintenance*, July 1933, pages 323-325. Intensified corrosion due to brine dripping from refrigerator cars and underestimation of future traffic when being built, call for repair and strengthening of many bridges. Electric welding greatly simplified the problem of applying additional metal to old bridge members or to replace metal destroyed by corrosion. Data (curves, charts, microstructures) from laboratory tests are presented demonstrating the strength of welded connections of 7 wrought iron plates to steel members and pointing to the advantage of using them for reinforcing work. Steel is affected by brine drippings. Various methods of applying wrought iron cover plates to built-up stringers and floor beams and to secure complete protection of the top flange from corrosion are illustrated. The fillets were 5/16" and were proportioned for an assumed working stress of 2500 lbs./lin. in. For the wrought Fe the average weld value was 9.280 lbs./lin. in. and for steel 9.520 lbs./lin. in. WH (4)

Electro Plating of Some Metals with Lead Peroxide (Die elektrolytische Plattierung einiger Metalle mit Bleisuperoxyd) *Die Metallbörse*, Vol. 22, July 2, 1932, page 835. See "The Electrolytic Coating of Metals with Lead Peroxide and Its Anti-Corrosion Properties," *Metals & Alloys*, Vol. 3, Nov. 1932, page MA 324. EF (4) 8

Corrosion Resistant Light Metal. (Korrosionsbeständiges Leichtmetall.) *Technische Blätter der deutschen Bergwerkszeitung*, Vol. 23, Aug. 6, 1933, page 427. After discussing the historical development of corrosion resistant light metal alloys (K.S. seewasser alloy with 4-5% Mg, elektron metal which attains its excellent properties by the special refining method) the properties of the new alloy Hydronalium are considered. Hydronalium contains 7-10% Mg, specific gravity 2.59-2.63, tensile strength 36-44 kg./mm.^{2} (in forged and pressed state), 17-26 kg./mm.^{2} as cast. Corrosion tests by submersion in 3% NaCl solution showed practically no decrease of tensile strength and elongation after 96 days, whereas with Duralumin the elongation decreased to 4.6% after 48 hrs. of submersion. Hydronalium still had 14% elongation. The high price of Hydronalium handicaps its extensive use. 9 GN (4)

What the School of Experience Has Taught a Dye Plant Operator About Construction Materials. *Chemical & Metallurgical Engineering*, Vol. 40, Feb. 1933, pages 62-63. Selection of basic materials for equipment is governed by general conditions pertaining to corrosion, temperature and physical properties. The lasting qualities of the material are of primary consideration and closely connected with these is question of first cost. Numerous examples are given of behavior of alloys in dye industry. PRK (4)

Pipe Line Protection. Dozier Finley. *Industrial & Engineering Chemistry*, Vol. 25, Sept. 1933, pages 1061-1062. The correspondent discusses some of the statements made by Stanley Gill on the subject of "Pipe Line Protec- 10 tion," regarding various pipe coatings. An answer by Gill is given. MEH (4)

Reduction of Corrosion in Water Pipe. C. R. Fellers & M. J. Mack. *Industrial & Engineering Chemistry*, Vol. 25, Sept. 1933, page 1050. Data are presented showing cost of treatment of water with lime in order to reduce corrosion in water lines. The pH is maintained at an average of 7.7. MEH (4)

The Dissolution of Magnesium in Aqueous Salt Solutions. Part I. Effect of Impurities. L. Whitby. *Transactions Faraday Society,* Vol. 29, Feb. 1933,
pages 415-425. Dissolution of 4 grades of Mg, none less than 99.90%,
was measured in N/10, N and 3N NaCl and N/20 HCl solutions. Large variations
in rate of dissolution were encountered in NaCl solutions, and it is considered
1 that duplication of results is impossible with Mg unless extremely pure metal is
used. Variations in the rate of dissolution are caused by changes in the type of
film formed at the cathode parts of the surface, dissolution in dilute HCl always
results in the same rate. Little difference is shown by hard-worked and fully annealed metal. The presence of about 0.02% of Mn causes an acceleration of attack
with time; in general, the action without the addition of Mn slows off with time.
A preliminary discussion of the mechanism of the attack is given. Heat treatment
in vacuo of a metal of high vapor pressure, such as Mg, will cause many of the
geometric irregularities of the surface to be smoothed off, thus lowering the
initial rate of dissolution. PRK + WAT (4)

Dissolution of Magnesium and Magnesium-Base Alloys by Natural and Artificial Seawaters. L. Whitby. *Transactions Faraday Society,* Vol. 29, Mar. 1933,
2 pages 523-531. H evolution/time curves have been obtained for Mg in N/2
NaCl solution and in seawater. The rate of attack in seawater was considerably
less than in N/2 NaCl, the difference was found to be due almost entirely to the
presence of sulphates in seawater. An artificial seawater was prepared capable of
reproducing the H evolution/time curves given by natural seawater. The effect of
addition of traces of saponin has been investigated and found to increase the rate
of H evolution compared with that of the same salt solution without saponin.
This effect is taken to indicate the presence of obstructive H films on the Mg.
Losses of weight of 3 Mg-base alloys (1) 6% Al, 1% Zn, 0.2% Si, 0.5% Mn,
92% Mg (2) 0.3% Si, 1.7% Mn and 98.0% Mg and (3) 10.0% Al, 0.6%
Zn, 0.3% Si, 0.5% Mn, 88.0% Mg and one type of duralumin have been obtained after both intermittent spray tests and total immersion tests in natural and
3 artificial seawater and in 2.5% NaCl solution. The results were substantially the
same as those given by pure Mg, but the differences were not nearly so pronounced after spraying as after immersion in different solutions. PRK + WAT (4)

Copper-Nickel Tubes, Their Advantages for Steam Condensers. Robert Worthington. *Metal Progress,* Vol. 24, July, 1933, pages 20-24. The strength
of the corrosion film formed on Admiralty brass is sufficient for use in the condensers of reciprocating engines where service of 10 to 20 years is obtained. Its
life is only 1 to 4 years in service on turbine ships due to the breaking of the
film under higher velocity of cooling water and failure to form again under that
condition. Cu-Ni tubes, of 20% Ni, due to the nature of the film formed on
them have much higher resistance. They have been in use 8-10 years with over
4 2,000,000 tubes in service now. Cu-Ni tubes cost twice as much as brass. A
diagram of lifetime of brass/lifetime of Cu-Ni in years shows time required to
equalize costs. 5 installations of Cu-Ni show years of service without failure where
brass would long since have failed. Savings in frequent repair and sawdust
dosing are real, but not readily expressed. In reciprocating condensers, corrosion
occurs by dezincification. In turbines, a more disastrous pitting action takes place
at points due to the impingement of entrained air bubbles at high velocity. WLC (4)

Erosion in Steam Turbines. C. R. Soderberg. *Mechanical World & Engineering Record,* Vol. 92, Mar. 3, 1933, pages 212-213. The amount of
erosion on the turbine blades is a function of both the degree of moisture and
the impingement velocity. The method of preventing erosion which is of interest
to the metallurgist is the increase of the erosion resistance of the blade material.
5 Tests have been carried out with W, Ta, "stellite," "contracide," "resistal," etc.
With this method of protection, blades with tip speeds exceeding 1200 ft./sec.
will now give as good service as ordinary stainless-steel blades for tip speeds of the
order of 900 ft./sec. Good results have been obtained with Ta and "stellite." Comparative results for stainless steel and "stellite" are graphically demonstrated.
Kz (4)

Corrosion of Iron in a Mixture of Water Vapor and Air. (Ueber die Korrosion des Eisens in einem Gemisch von Wasserdampf und Luft.) E. J. Dyrmont. *Korrosion,* Vol. 8, June 25, 1933, pages 22-24. From Mitteilungen des Metallinstituts, Leningrad, 1931, pages 37-45. An apparatus is described in which iron samples were subjected to corrosion under conditions which attacked them faster than under natural conditions (in air). The beginning of corrosion could be detected, with only H_2O vapor, after 40 hrs. while with CO_2 in addition, as corresponds with natural air, the first traces of rust showed after 5 hrs. and with a mixture of O and CO_2 after ½-1 hr. Addition of S containing gases accelerated the attack still more, after 15 min. the first signs showed. If the temperature is increased the velocity of corrosion is more rapid and certain colors are formed which are so distinctive that they can be used to determine the composition of the attacking atmosphere. Practical results of these investigations were used in eliminating defects which occurred, for instance, when medical instruments were sterilized and later corroded; proper sterilizing temperature adjusted the O concentration in the sterilizing liquid to the least O concentration and eliminated the effect. Some other examples are described. Ha (4)

Coatings for Pipe Lines. *Gas Engineer,* Vol. 57, July 1932, pages 422-424; Aug. 1932, pages 450-455; Sept. 1932, pages 515-517; Oct. 1932, pages 568-570. Details on some recent investigations based upon observations and measurements made on different burial tests of pipe coatings. The main information is taken from a paper of Ewing before the American Gas Association, 1931. WH (4)

Corrosion of Water Heaters. (Rostungserscheinungen in Warmwasserbereitern.) *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, June 18, 1933, pages 344-345. In commenting on the results of the investigations of Daeves & Grossschupff (*Metals & Alloys,* Vol. 4, Apr. 1933, page MA 104) the fact is verified that the construction plays an important role in preventing corrosion in water heaters. GN (4)

Investigations on the Corrosion Caused by Cavitation. (Untersuchungen über die durch Kavitation hervorgerufenen Korrosionen.) P. de Haller. *Schweizerische Bauzeitung,* Vol. 101, May 27, 1933, pages 243-246; June 3, 1933, pages 260-264. The experiments described were carried on at the hydraulic laboratory of the Escher-Wyss Co. and show that the corrosion caused by cavitation is of mechanical but not of chemical nature. A method was developed for the measurement of the pressure exerted in the zone of cavitation. By means of a piezo-electric cell and a tube amplifier the fluctuations in pressure are transformed into voltage and recorded by a cathode ray oscillograph. The hammering of the water drops takes place with about 20,000-25,000 cycles. At these frequencies pressure maxima of 160 kg./cm.^{2} occurring in the middle of the zone of cavitation are observed. The effect of the surface condition of the part subjected to cavitation was also studied, showing that increased hardness retards corrosion through cavitation. GN (4)

Treatment of Condenser Cooling Water by Gaseous Chlorine in Order to Remedy the Deterioration in Condenser Tubes, Pipes and Tanks. (Le Traitement des Eaux de Refroidissement des Condenseurs par le Chlore Gazeux comme Remède à la Détérioration des Tubes de Condenseurs, des Tuyauteries et des Bâches.) P. Lionel Boucher. *La Revue Industrielle,* Vol. 62, July 1932, pages 353-358. With commonly used water, condenser tubes are soon covered with a micro-organism coating which has a low thermal conductivity and reduces the efficiency of the apparatus. This coating can only be removed by hand cleaning. Chlorine in very small quantities, when present in water, prevents the formation of such a micro-organism coating. Such quantities are too low to cause corrosion. Description of installations for introducing Cl in water in numerous power plants. Cl treatment can also be used to advantage when sea water is used. The Paterson Chlorine Process is described. FR (4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Studies Upon the Widmanstätten Structure, IV. The Iron-Carbon Alloys. ROBERT F. MEHL, CHARLES S. BARRETT & DANA W. SMITH. *American Institute of Mining & Metallurgical Engineers, Contribution* No. 37, Feb. 1933, 35 pages. It is known that ferrite separates as plates along the {111} planes of austenite when a hypoeutectoid alloy is slowly cooled. The orientation of the ferrite with respect to the parent austenite was obtained from etched figures. Upon each of the 4 (111) planes in austenite, ferrite forms in plates of 6 distinct orientations, resulting in a total of 24 ferrite orientations from each austenite grain. A (110) plane of ferrite is parallel to the (111) plane of austenite and the direction [111] and [011] of ferrite and austenite respectively are parallel. In hypereutectoid alloy traces of the Fe_3C plates on 3 mutually perpendicular planes were determined and pole figures representing the plates constructed. These indicated that the normals to the plates were grouped around 3 mutually perpendicular directions. The plates therefore form on some austenitic plane of high indices, definitely not {111}, but near the {100} planes. Laue patterns of separated Fe_3C plates indicated that the (001) plane of Fe_3C was parallel to the surface of the plate, but that there was fibering with the [100] Fe_3C as a fibering axis. A study of quenched samples proved that the martensitic structure in both low-C and high-C alloys is delineated by {111} in the austenite lattice. Mechanism of the transformation $\gamma \rightarrow \alpha$ as determined by Kurdjumow and Sachs is described. Appendix A describes the method used in determining the orientation of Fe_3C plates using reciprocal lattices, and Appendix B gives directions for plotting of atoms on the (hkl) plane of a cubic lattice. 36 references. JLG (5a)

The Hardening Transformation in Manganese Steels. H. SCOTT & J. G. HOOP. *Transactions American Society for Steel Treating,* Vol. 21, Mar. 1933, pages 233-259. Paper presented before Buffalo Convention, Oct. 1932. Temperature of hardening transformation Ar″ for steels with 4.5 to 12.0% Mn and 0.2 to 1.0% C was determined by dilatation tests. Temperatures determined under conditions assuring solution of all C are shown. Critical cooling rate of a 1.0% C, 4.5% Mn steel is 200° C./min. Austenitic microstructure results at room temperature which transforms to martensite on cooling in liquid air. C in solid solution is 12 times as effective as Mn in lowering Ar″. A smooth curve showing this relation is given. C must be in solid solution. Curve for Ar″ versus C content of Mn-free steels is constructed from data on Mn steels. Includes discussion. 16 references. WLC (5a)

Transformation of Austenite. (Ueber die Umwandlung des Austenits.) M. v. SCHWARZ & H. MÜLLER. *Archiv für das Eisenhüttenwesen,* Vol. 6, May 1933, pages 511-514. In a cylinder 20 mm. diam., 25 mm. long, of steel containing 1% C, 0.15% Si, and 0.33% Mn, oil quenched from 1240° C., the structure consisted of martensite, austenite, and troostite in the exterior layer, and of troostite and retained austenite in the core. The presence of the retained austenite in the core was attributed in part to segregation. In the formation of martensite in hypoeutectoid steel the separation of ferrite plays an important part. In these steels twinning in the martensite was observed; this appeared to be inherited from the parent austenite, and did not seem to result from the strains set up during quenching. SE (5a)

The Constitution of the Lead-Tin Alloys. D. STOCKDALE. *Metal Industry,* London, Vol. 41, Nov. 11, 1932, pages 471-473; Nov. 25, 1932, pages 521-523. See *Metals & Alloys,* Vol. 4, Feb. 1933, page MA 33. Ha (5a)

The Investigation of Thin Films on Metals by Means of Reflected Polarized Light. LEIF TRONSTAD. *Transactions Faraday Society,* Vol. 29, Mar. 1933, pages 502-514. A survey is presented of the experimental and theoretical aspects of Drude's optical method which uses reflected polarized light in the examination of metallic surfaces. As examples are mentioned some of the results hitherto obtained in investigating, (1) passivity of metals, (2) oxidation of metals, (3) adsorption of metals, and (4) monomolecular films on metals. Attention is called to some other fields in which the optical method may prove fruitful, as heterogeneous catalysis, and surface migration. WAT (5a)

Physico-Chemical Study of the Alloys of Silicon with Aluminum. (Silumin.) G. G. URASOW & A. A. LARIN. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 6, 1933, pages 253-254. The modification was made by melting the silumin under a flux of CaF_2 and NaF. The electrical resistance of the quenched alloys demonstrated that at 500° C. the Si is soluble to 1.5-1.6% in Al. The hardness of the modified alloys increases rapidly in the region of solid solution. NA (5a)

Diagram of the Ternary System: Lead-Iron-Sulphur. G. G. URASOW, P. A. VOROBIEW & J. V. AINBINDER. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 6, 1933, page 254. Investigation of the diagram of the ternary system of Fe, Pb and S make it possible to characterize the direction of the reaction: $PbS + Fe \rightleftharpoons FeS + Pb$ in relation to the temperature. The reaction at high temperature moves from right to left and at the temperature of crystallization in the reverse direction. NA (5a)

Ternary System: Aluminium-Copper-Silicon. G. G. URASOW, S. A. POGODIN & G. M. ZAMARUEW. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 6, 1933, pages 265-266. The thermal method was used for construction of the liquidus of the part of the ternary diagram in concentrations up to 24% Si and 40% Cu. The boundary of the ternary solid solutions of Cu and Si in Al at different temperatures was determined by microscopic investigation of the quenched alloys. The ternary eutectic has the composition: 5% Si, 27% Cu and 68% Al and the temperature 525° C. The hardness of the ternary alloys was also determined by Brinell method. NA (5a)

Carbon in Cast Irons. (Le carbone des fontes.) E. VROONEN. *Revue de Métallurgie,* Vol. 30, June 1933, pages 238-253. The best criterion for evaluation of C in cast irons is to recalculate it to eutectic composition. Si and P must be accounted for, and on the basis of production analysis "index of carburization" formulas i.c. = C: (4.3 — 0.276P); i.c. = C: (1 — 0.0642 P — 0.03 Si) or i.c. = C: (4.3 — 0.276 P — 0.129 Si) are proposed. Mn and S present seemingly do not affect these equations. Index of carburization varies greatly from heat to heat and in the portions of the same heat. An attempt was made to connect fluidity on casting and soundness of castings with this factor but no definite conclusions could be reached. JDG (5a)

Martensite Forms Instantly. H. J. WIESTER. *Metal Progress,* Vol. 23, Feb. 1933, pages 46-48. When a 1.7% C steel is quenched in a metal bath at 100° C., pearlite crystallization is suppressed, the undercooled austenite is stable if held at this temperature and can be ground, polished and etched. This is done by holding the specimen in an electric soldering Fe. Homogeneous austenite is thus obtained for observation. As the steel cools, martensite crystallizes out and appears in relief as the change involves an increase in volume. Moving pictures made of this change show that the martensite needles appear suddenly and grow no larger. The precipitation is uneven, the needles forming at random places. The change is shown by 4 successive exposures at 20 per second. The theory of this jerky change is discussed. WLC (5a)

On the Equilibrium A_3 and Acm Points in Pure Carbon Steels. YAP, CHU-PHAY. *Transactions American Society for Steel Treating,* Vol. 21, Mar. 1933, pages 260-268. Work of Sato on influence of rate of heating and cooling on Ac_3 and Acm points is discussed. New values of A_3 and Acm have been derived based on work of Sato, using a differential dilatometer. They are A_3 (ordinarily pure Fe), 900° C.; A_1, 720° C., and 0.8% C; Acm line a straight line from 0.795 at 720° C. to 1.685% C at 1130° C. Results of previous investigators are discussed. Results given agree closely with other workers. 7 references. WLC (5a)

The Structure of Quenched Carbon Steels (Der Gefügeaufbau abgeschreckter Kohlenstoffstähle) H. Esser & E. Engelhardt. *Archiv für das Eisenhüttenwesen,* Vol. 6, Mar. 1933, pages 395-398. The microstructures of quenched hypoeutectoid and eutectoid steels were studied. The structures did not conform exactly to Hanemann's descriptions of the various types of martensite he named and considered to be of definite C content. It is mentioned that Hanemann has abandoned his phase diagram of the quenched steels. (See *Archiv für das Eisenhüttenwesen,* Vol. 6, 1932, pages 199-207.) The authors list 8 reasons—all rather questionable—to prove that the carbon in martensite is not in solution but is present as finely divided particles of cementite. SE (5a)

Recrystallization Power and Shear Hardening in Aluminum Single Crystals. W. G. Burgers. *Nature,* Vol. 131, Mar. 4, 1933, pages 326-327. Recrystallization experiments with stretched Al single crystals seem to indicate that, for the same amount of shear, the number of crystallites formed under identical conditions of heat treatment is the smaller the greater the number of slip-planes involved in the distortion. During plastic extension or compression of Al single crystals, the resistance to slip seems not to be materially influenced by a "division" of the slip over several planes. The shear-hardening depends only on the total amount of shear. Kz (5a)

Cast Steel; Structure—Thermal Treatments—Properties. (L'Acier Moulé. Structure—Traitements—Propriétés.) Georges Delbart. *Bulletin de l'Association Technique de Fonderie,* Vol. 7, Mar. 1933, pages 87-110. Properties of cast steel depend principally upon: (1) chemical composition, (2) state of oxidation and inclusions, (3) solidification of liquid metal to state of solid solution, (4) transformation of solid solution into alpha iron and pearlite, (5) thermal treatments which modify character of primary and secondary structures. Number of centers of crystallization depends upon: (1) chemical composition (e.g. Ni and V increase number of nuclei), (2) homogeneity of liquid solution, (3) cooling rate, (4) inclusions. Slow cooling in time of solidification favors formation of dendritic structure. In austenitic field, slow cooling favors homogeneity of solid solution. Slow cooling in A_3-A_1 interval facilitates formation of Widmanstätten structure. 6 references. WHS (5a)

Lapping Retains Graphite. Correspondence from Charles Y. Clayton. *Metal Progress,* Vol. 23, Jan. 1933, pages 47. 2 micrographs of malleable Fe showing temper C in place are shown. The method used was smoothing down on 00 emery on a fast wheel, finish on horizontal polishing lap covered with pitch, using moistened levigated alumina as abrasive. WLC (5a)

The Nature of the Solid Solution of Aluminum in Silver. Charles S. Barrett. *Metals & Alloys,* Vol. 4, May 1933, pages 63-64, 74. 7 references. The reported "abnormal" type of solid solution of Al in Ag was investigated using extreme care in preparing the alloys and more precise X-ray methods. The preparation and methods are described in detail. The analysis, density measurements, lattice dimensions, and calculated densities are tabulated. Slowly cooled alloys gave sharper patterns, which are shown, than the quenched alloys. Contrary to previous results, a comparison of observed and calculated densities show this solid solution to be of simple substitution type. Solid solution of Al in Ag decreases the density linearly at the rate of 0.069 per atomic % of Al, and the lattice parameter 0.0012 A. U. per atomic % of Al. Graphs show comparison of the measured and calculated densities of the author's results and others, the same for the X-ray results. WLC (5a)

Some Considerations Concerning the Theory of Recrystallization. E. F. Bakmetev, A. A. Botchwar, G. S. Shdanow & J. S. Umanskij. *Journal tekhnicheskoj fiziki,* Vol. 2, May 1932, pages 161-172 (In Russian). A general discussion of recrystallization phenomena for an ideal monocrystal subject to deformation. Recrystallization is considered as a process of decay of local inhomogeneities of inner energy distribution followed by growth of new structural formations endowed with minimum of inner energy. The above conceptions are then summarily applied to the case of a real polycrystalline aggregate. LI (5a)

Solubility of Silicon in Aluminium in Solid State at Different Temperatures. P. Y. Soldau & M. B. Danilowich. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 6, 1933, pages 81-89. The limit of solubility of Si in Al at room temperature is lower than 0.17% Si and remains without change to 300°. At 400° C. the solubility reaches the composition of 0.3% Si, at 480° 0.65% Si, at 560° 1.25% Si. At the eutectic temperature (570° C.) the solubility is 1.32% Si. NA (5a)

Solubility Curve of the Copper in Aluminium in Solid State. P. Y. Soldau & N. G. Anisimow. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 6, 1933, pages 69-79. The solubility curve of Cu in Al was determined by the microscopic examination of the quenched alloys in the temperature intervals from 15° to 500° C. The limit of the solid solubility at 15° is 2.7% Cu and the same limit holds up to 300° C. The solubility curve lies at 400° with 3.12% Cu and at 500° with 5.55% Cu and cuts the eutectic line (543°) at 6.5% Cu. Age-hardening was observed for the quenched alloys with copper contents from 2.7% to 6.33%, with a maximum effect at 6% Cu. In conclusion the causes of the difference in the data of various investigators are considered. NA (5a)

Heat Evolutions During the Tempering of Quenched Carbon Steels. (Die Wärmetönungen beim Anlassen abgeschreckter Kohlenstoffstahle.) F. Stäblein & H. Jaeger. *Archiv für das Eisenhüttenwesen,* Vol. 6, Apr. 1933, pages 445-451. Quenched samples of 0.07 to 1.49% C steel were heated by an electric resistor placed within the sample and differential thermal analysis curves obtained in tempering; the differences in heat evolution between the quenched samples and the comparison bodies were calculated. For quenched 0.9% C steel the total heat evolution on tempering was 10 cal./g. Almost half of this heat evolution occurred during the breakdown of the retained austenite on tempering at about 300° C. The heat evolution during the transformation from tetragonal to cubic martensite could not be determined exactly. 52 references. SE (5a)

On Residual Austenite in Hardened Steel. S. S. Steinberg & W. I. Zuzin. *Journal technicheskoj fiziki,* Vol. 2, Mar. 1932, pages 35-46 (In Russian). Amount of residual austenite has been determined in several samples of hardened C steel with 0.62-1.6% C from the decrease of magnetization intensity at saturation, using a special set-up of apparatus for ballistic measurements. The amount of austenite is found to increase with C content. For increasing preheating temperatures the austenite content is found to rise up to the temperature 950°-1000° C.; for higher temperatures it begins to decrease. Slow cooling produces a higher austenite content than rapid cooling, except for steel with 1.6% C. Granular form of cementite is found to give less austenite than the laminar form. Aging at 100° C. does not produce a noticeable decomposition of austenite. LI (5a)

The Segregation of the α-Phase in β-Brass. (Über die Ausscheidung der α-Phase im β-Messing.) M. Straumanis & J. Weerts. *Mitteilungen der deutschen Materialprüfungsanstalten,* Sonderheft 21, 1933, pages 26-33. Phenomenon of segregation of cubic face-centered β-phase from the Cu rich space centered α-phase of Cu-Zn alloys was investigated by X-rays and microscopically. The α-crystallites are orientated, independently from the heat treatment, strictly regularly to the lattice of the β-crystal in 24 different positions. Transformation can be explained by sliding and is crystallographically reversible. Segregation takes place at strong undercooling and strong oversaturation at low temperatures while at higher temperatures regular growth occurs with much greater variety in orientation and arrangement of the crystal nuclei. The results are illustrated by numerous refraction patterns and micrographs which show very clearly the various forms of crystals and their arrangement. 37 references. Ha (5a)

Allotropic Transformations of Iron at the A_3 and A_4 Points. (Sur les transformations polymorphes du fer aux points A_3 et A_4). V. N. Svechnikoff. *Revue de Métallurgie,* Vol. 29, Dec. 1932, pages 583-587. Translation of article which appeared in *Domez,* No. 4-5, 1932, pages 29-32. See *Metals & Alloys,* Vol. 4, July 1933, page MA 212. JDG (5a)

Structure & X-Ray Analysis (5b)

Eutectoid Transformation of Bronze. GUNJI SHINODA. *Suiyokwai-shi,* Vol. 7, Nov. 25, 1932, pages 367-372. Bronzes containing 22.38% and 25.70% Sn were quenched from 650° C. and their internal structures were investigated by Cu- K α X-ray. The β-phase has a body-centered cubic lattice whose constants are respectively 2.973 A.U. in 22.38% Sn and 2.981 A.U. in 25.70% Sn. This β is transformed into β' by tempering and then β' is decomposed into α and δ-like one. The alloy containing 25.70% Sn, quenched from 730° C. proved to consist of a body-centered tetragonal lattice of α = 2.889 A.U. and c/a 1.059. HN (5b)

X-ray Investigations on the Thermal Expansion of Solid. GUNJI SHINODA. *Memoirs College of Science, Kyoto Imperial University,* May 1933, pages 194-201. The thermal expansion coefficients and the lattice constants of some metals have been determined by X-ray method and the following: expansion coefficient (10-6) — Al (α = 22.9), Sn ($\alpha_{\parallel}$ = 45.8, $\alpha_{\perp}$ = 25.7). In ($\alpha_{\parallel}$ = 45.0, α = 11.7), Zn ($\alpha_{\parallel}$ = 64.5, $\alpha_{\perp}$ = 10.8), Tl ($\alpha_{\parallel}$ = 72, $\alpha_{\perp}$ = 9) and lattice constant — Sn (α = 5.824 A.U., c/a = 0.5415), In (α = 4.581 A.U., c/a 1.077). HN (5b)

Structures of Kish Graphite. SHINICHI SHIMAZU. *Memoirs College of Science, Kyoto Imperial University,* May 1933, pages 215-218. Kish graphite of pig iron produced at the Kenjiho steel works in Korea has been examined by X-ray method and it was observed that kish graphite flakes had a tendency to arrange themselves in a fibrous manner with the axis [11$\bar{2}$0] as the fibrous axis in the direction parallel to the flat surface of the flake. HN (5b)

Self-diffusion in Solid Lead (Die Selbstdiffusion im festen Blei) W. SEITH & A. KEIL. *Zeitschrift für Metallkunde,* Vol. 25, May 1933, pages 104-106. The self-diffusion of solid lead is measured by determining the decrease with time of the α-ray activity in lead surfaces impregnated with the lead isotope ThB, which decrease results from the diffusion of the isotope inwards, with corresponding decreased escape of α-rays. By proper technique diffusion coefficients of the order of 10^{-7}cm.^{2}/day may be measured. The self diffusion of lead in single crystals of lead was measured at 17 temperatures between 182° and 324° C.; the results conform to an equation $D = A.e^{-B/T}$ where D is the diffusion coefficient, A a constant, and $B = \frac{Q}{T}$ where Q is the "heat of lattice loosening" (Auflockerungswärme). D at 182° is found to be 4.12 x 10^{-8} and at 324° 4.78 x 10^{-5} cm.^{2}/day, A to be 5.76, and Q to be 27,870 calories; these values are not sensibly different in multi-crystalline Pb, nor in Pb distorted by milling, contrary to previous work which is now known to have been invalidated by improper preparation and inoculation of the surface [Nature 115, 674-5 (1925)]. By using α-rays of shorter range smaller diffusion constants may be measured, though at lower degrees of accuracy; in this way D was measured between 106° and 153° and found to vary between 1.45 x 10^{-11} and 3.29 x 10^{-1} cm.^{2}/day, the values falling upon an extrapolation of the curve obtained at higher temperatures. Thus self diffusion in Pb is independent of structure, though in other metals such is not the case. The influence upon self diffusion in Pb of additions of other metals is being studied. RFM (5b)

Structure of Surface of Polished Metal Crystals (Ueber die Struktur der Oberfläche geschliffener Metallkristalle) W. BOAS & E. SCHMID. *Mitteilungen der deutschen Materialprüfungsanstalten,* Sonderheft 21, 1933, pages 39-42. 10 references. See *Metals & Alloys,* Vol. 4, June 1933, page MA 174. Ha (5b)

Testing of Welds by X-rays. R. A. STEPHEN. *Mechanical World & Engineering Record,* Vol. 91, June 3, 1932, pages 529-531. See "X-rays in the Welding Industry," *Metals & Alloys,* Vol. 4, Apr. 1933, page MA 108. Kz(5b)

X-Ray Study of Internal Stresses in Hardened Cobalt Steels. J. UMANSKIJ & E. GORDON. *Journal tekhnicheskoj fiziki,* Vol. 2, June 1932, pages 323-329 (In Russian). Deformations of crystal lattice causing the high coercive force of Co steels were determined by the measurement of intensity ratios of X-ray spectral lines, as proposed by Mark and Hengstenberg. The intensity ratio I (200)/J (411) for a Co-W-Cr steel (29.60% Co; 8.1% W; 2.73% Cr; 0.73% C), having a coercive force of 225 gauss is 1.4 times as great as for a similar steel with 2.75% Co. The results point to a very strong deformation of crystal lattice of martensite in hardened Co-steels. The high coercive force being observable in hardened steels only, it is to be inferred that the deforming action of Co atoms on crystal lattice is effective only after hardening. LI (5b)

Recrystallization Phenomena (Rekristallisationverschijnselen) A. E. VAN ARKEL. *Polytechnisch Weekblad,* Vol. 26, June 23, 1932, pages 397-400; June 30, 1932, pages 405-409; July 9, 1932, pages 421-424; July 14, 1932, pages 437-440. The extensive survey on present state of recrystallization comprises following chapters: gliding, disturbances during the gliding process, internal stresses and their appearance in the Debye diagram, annealing recrystallization nuclei and lattice distortions, velocity of recrystallization, crystal growth, effect of crystal boundaries upon physical properties, recrystallization of crystal units, effect of the crystal size on the appearance of recrystallization, deformation limit, limit of crystal growth due to deformation, so-called secondary recrystallization, hypotheses on nuclei formation, growing together of polycrystals, connections between crystal orientation before and after recrystallization, hypothesis on growing together, annealing and recrystallization at different temperatures, recrystallization and growing together at different temperatures, practical conclusions with reference to the manufacture of crystal filaments. WH (5b)

Novel Analytical Method for Testing Materials Employed in Aircraft Construction (Nuevos métodos de análisis aplicables a los materiales empleados en la aviácion) J. VAZQUEZ-GARRIGA. *Revista de Aeronatica,* Vol. 1, May 1932, pages 79-81. Discussion on utilization of X-rays for inspection of aircraft members. WH (5b)

X-Ray Investigation into the Al-Zn System (Über röntgenographische Untersuchung am System Al-Zn) *Die Metallbörse,* Vol. 22, Aug. 10, 1932, page 1023. Paper before the Kaiser Wilhelm Institut für Metallforschung, June 1932. Wassermann & Schmid found by X-rays that the solubility of Zn in the γ solid solution is very small at low temperatures, but considerably increases with rising temperatures. The β constituent which is stable above 270° C. and hitherto considered as the intermetallic compound Al_2Zn_3 shows the same structure as the Al-rich γ solid solution. It is highly indicative that there is no β-phase. EF (5b)

Structure of Pressed Duralumin after Thermal Treatment. E. F. BAKHMETEV & M. D. VOZDVIJENSKY. *Proceedings Aviation Materials Research Institute,* Vol. 1, 1933, pages 50-60 (In Russian). Structures of duralumin cold and hot deformed by impact were compared by X-ray method before and after annealing. Cold deformation blurred lines on radiograms. Hot deformed metal showed splitting of double lines. With the same degree of deformation cold treated samples partially recrystallized after annealing at 350° C. for 5 hours and fully after 450° C. Hot deformed were not affected at all by 350° annealing, partially recrystallized after 450° and required 520° C. for complete recrystallization. With smaller amounts of deformation 520° C. resulted only in partial recrystallization. Hot deformation at a rate greater than recrystallization speed produces less inequalities in distribution of internal energy than cold work and, therefore, reduces tendency to recrystallization. During deformation at the rate slower than recrystallization speed some crystallites with undistorted space lattice are formed. As the recrystallization speed diminishes with time, they become somewhat strained. These crystallites consist of aggregates of smaller crystallites with a somewhat different orientation. They fall within the angle of the same ray beam and cause the blurring of Laué spots. Blurring persists within a wide range of annealing temperatures showing unusual stability of structure produced by hot deformation. (5b)

On Nickel Carbide and Its Relation to the Rest of the Carbides of the Element Series Sc-Ni (Über das Nickelcarbid und seine Beziehung zu den übrigen Carbiden der Elementreihe Scandium-Nickel) B. JACOBSON & A. WESTGREN. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 20, Apr. 1933, pages 361-367. X-ray analysis of Ni_3C prepared by carburizing pure Ni powder with CO, disclosed a hexagonal close-packed arrangement. The dimensions of the elementary cell of the metal atom lattice yielded a = 2.646 A.U., c = 4.329 A.U. and $\frac{c}{a}$ = 1.636. A solubility of C in solid Ni and an extension of the homogeneity range of Ni_3C could not be proved by X-rays. The crystal structure of Ni_3C is not in agreement with the rule of G. Hägg (*Zeitschrift für physikalische Chemie,* Abt. B, Vol. 12, Feb. 1931, pages 33-56) concerning the structure of carbides, borides and hydrides of transition elements in spite of the fact that the ratio of the metal atom radius: metalloid radius for C and Ni is 0.62, i.e. well above the critical value of 0.59. Thus Ni does not fall in line with the metals of the Sc-Ni group which possess relatively small atoms comprising Cr, Mn, and Fe. The latter form carbides of complicated structure. The investigators consider Ni_3C as an unstable compound which is probably only stable at a pressure of hundreds of thousands of atmospheres. The Hägg law only covers stable compounds thus explaining the apparent exception in case of Ni_3C. EF (5b)

Determination of Phase Boundary Lines of Cu-Zn Diagram by X-Rays (Röntgenographische Bestimmung der Phasengrenzlinien des Cu-Zn-Diagramms) AXEL JOHANSSON & A. WESTGREN. *Metallwirtschaft,* Vol. 12, July 17, 1933, pages 385-387. Cu-Zn alloys were prepared by melting electrolytic Cu and Zn, casting in iron molds and thoroughly homogenizing at 600-800° C. Some of the samples were heated in evacuated glass or quartz tubes and quenched in water. X-ray photograms were made and the lattice parameters calculated. From them a number of points on the boundary lines of the Cu-Zn constitutional diagram were determined. The results check closely with the diagram of Bauer and Hanson which was obtained by the older metallurgical methods, better than the X-ray determinations of Owen and Pickup. The object of the investigation was to prove that X-ray methods were accurate for the determination of constitutional diagrams. 8 references. CEM (5b)

On the Arrangement of the Micro-crystals in Copper and Gold deposited by Electrolysis. HIEKI HIRATA & YOSHIO TANAKA. *Memoirs College of Science Kyoto Imperial University,* (A) 15, Jan. 1932, pages 9-22. The arrangement of the micro-crystals in electro-deposited Cu and Au were examined by X-rays. Cu is deposited electrolytically without any regularity under ordinary conditions, but under certain conditions it tends to deposit in a fibrous manner, with the axis [110] in common: occasionally the rotation of micro-crystals of Cu about this axis is so small that they form a crystalline structure nearly the same as that of a single crystal. The direction of the maximum growth and that of the normal to the "parallel growth" natural crystal. Some of the fibrous specimens consist of 2 groups of micro-crystals rotating around the [110]: in one of these groups a micro-crystal is so situated to form a "spinell type" twin with another micro-crystal belonging to the other. Gold has no marked tendency to be electro-deposited with regularity. HN (5b)

Radiographic Examination of Metals by Means of Gamma Rays and of Radio-Active Bodies (Examen Radiographique des Métaux au Moyen des Rayons Gamma et des Corps Radio-Actifs) M. HOLWECK. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 3, Mar.-Apr. 1932, pages 583-590. Lecture before Société des ingénieurs Soudeurs. A tube containing radium or mesothorium can be used as radiating source the intensity of which is of course much less than that of an X-ray Coolidge tube but such a γ-ray tube is easily transportable. For photography, time of exposure is as long as 15 hours, this time depending upon 3 factors: (1) quantity of radium used, (2) distance between radium and film, (3) thickness of piece to be studied. For instance for an iron thickness of 10 cm., 250 mg. are needed but for an iron thickness of 15 cm. 1185 mg. are necessary to obtain a good photograph. A defect representing 2-4% of thickness of casting can be detected by this method. A pin hole of 3 mm. is detected in a 10 cm. thick casting. Practically the users cannot buy the radium but they could rent the tube for the necessary time. Examples of application of the method are given. FR (5b)

X-Raying Welded Steel Plates up to 4" Thickness. R. E. HILLER. *Engineering News-Record,* Vol. 110, Feb. 16, 1933, pages 220-221. See *Metals & Alloys,* Vol. 4, June 1933, page MA 174. CBJ (5b)

Comments on Technique of X-Ray Materials Testing (Versuchtechnische Betrachtungen über die Material-Roentgenprüfung) III. A. HERR. *Mitteilungen des Technischen Versuchsamtes Wien,* Vol. 21, 1932, pages 46-59. The fact is pointed out that with increasing application of X-ray tests of materials public safety has been greatly increased, the proper evaluation of the test results having furnished the basis for standards which have to be adhered to in purchasing materials. Coarse and fine structure, diascopy (through-radiation), perfection of X-ray apparatus for laboratory and particularly in portable apparatus for shop tests or tests on site, safety arrangements for personnel are discussed at length and several apparatuses for voltages up to 500 kv. are described. 20 references. Ha (5b)

Effect of the Direction of Drawing on the Arrangement of the Micro-crystals in Al-wire and Its Tensile Strength. TAKEO FUJIWARA. *Memoirs College of Science, Kyoto Imperial University,* (A) 15, Jan. 1932, pages 35-42. The micro-crystals of Al-wire cold drawn in the same direction are so arranged that the axes [111] are inclined to the direction of the drawing toward the outside, forming a cone. In the case of the wire drawn in reverse directions alternately, the micro-crystals are so arranged in the exterior part that the [111] are inclined to the axis of the wire on both sides, and the amount of their angle is less than that of the wire drawn in the same direction. In both wires the inclination of the [111] become smaller the more the wires are reduced. The wire drawn in the same direction is hardened more and shows the higher strength. HN (5b)

Vacant Positions in the Iron Lattice of Pyrrhotite. G. HÄGG. *Nature,* Vol. 131, Feb. 4, 1933, pages 167-168. Investigations on solubility of S in FeS have led to conclusion that solid solutions of S in FeS are formed by substituting some of Fe atoms in original lattice by S atoms. Another explanation is that excess of S is caused by an increasing number of vacant positions in Fe lattice. Kz (5b)

The Arrangement of the Micro-crystals in the Film of Molybdenum Obtained by Deposition. TAKEO FUJIWARA. *Memoirs College of Science, Kyoto Imperial University,* (A) 15, Jan. 1932, pages 31-33. By means of Laué photographs the arrangement of the micro-crystals in the thin film of molybdenum obtained by deposition was studied. They are composed of micro-crystals which are so arranged that the (110) plane is almost in the flat surface of the film and a cube edge is nearly parallel to the lengthwise direction, but some of them are composed of somewhat large micro-crystals, which are arranged fibrously with the [110] axis as fibre axis which is normal to the flat surface of the film. HN (5b)

Determination of Crystal Lattice Constants by Electron Diffraction. G. I. FINCH & A. G. QUARRELL. *Nature,* Vol. 131, June 10, 1933, page 842. Description of an experiment by which the crystal lattice constants can be accurately determined by electron diffraction. Kz (5b)

Ratio of Adsorption of Radium-B and Radium-C on Nickel. J. A. CRANSTON & C. BENSON. *Journal Royal Technical College,* Vol. 3, Part I, Jan. 1933, pages 52-56. In a HCl solution of radium-B and radium-C, to which Ni is added, pure radium C is adsorbed for strengths of HCl greater than normal, but diminished acidity gives a marked increase in proportion of radium-B absorbed. It is also shown that while electrode potential existing between Ni and solution may be a factor in determining ratio of adsorption of radium-B to radium-C in neutral solutions, acidity is predominating factor in solutions which are not neutral. JWD (5b)

Structure Analogies of Alloys. ARNE WESTGREN. *Transactions American Society for Steel Treating,* Vol. 20, Dec. 1932, pages 507-528. The author points out that equilibrium diagrams fail to indicate the amount of analogy which actually exists between various alloy systems. There are discussed analogies occurring in Cu, Ag and Au alloys with Zn, Al, Sn and Sb and the relation between structure and concentration of valency electrons. Phases of the same structure as β-brass and γ-brass are of interest as they seem to be formed when the ratio of valency electrons to the number of atoms assumes the values 3:2 and 21:13 respectively. In some cases where a β-brass structure would be expected in accord with this rule a phase isomorphous with β-Mn is found. When elements such as Fe, Pd and Pt are combined with Zn, Cd or Al phases analogous to β- or γ-brass are formed in accordance with the above rule when the transition metals Fe, Pd and Pt are considered to have zero valency. WLC (5b)

Structure Analogies of Intermetallic Phases. A. WESTGREN & W. EKMAN. *Arkiv för Kemi, Mineralogie och Geologie,* Vol. 10 B, No. 11, 1932, 6 pages. (In English.) The lattice types of the intermediate β and γ phases occurring in the Cu-Zn system have been found to recur regularly in many binary alloys containing Cu, Ag or Au. The connections between structure type and the valency of the atoms indicates that in the cases discussed the stability of the lattice primarily depends upon the existence of a certain number of electrons, which seem in some way to belong to the lattice in its entirety. Only secondarily have the origin of these electrons or the properties of the atomic cores any influence upon the atomic grouping. Recently several compound metallic phases have been found which do not contain Cu, Ag or Au and yet have their atoms grouped in the same way as β or γ brass as for instance NiAl, MnAl, FeAl. With respect to the latter the atoms of the transition elements do not seem to contribute any of their electrons to those common to the lattice but act as being zero valent. The homogeneity range was determined for CoZn (15-22%) and NiZn (15-19% approximately). If Co rises above 22 atomic % a phase appears having the β Mn structure ($CoZn_3$?) like Ag_3Al and Cu_5Si. The alloying of a transition element with Al, Zn or Cd is accompanied by a decrease in volume of the system much more pronounced than when alloys are formed only of atoms with complete inner electron shells. WH (5b)

X-Ray Testing of Iron and Steel (Röntgenprüfung von Eisen und Stahl) F. WEVER. *Stahl und Eisen,* Vol. 53, May 11, 1933, pages 497-505. A review of non-destructive testing by magnetic methods, X-rays, and γ-rays. In magnetic testing the chief difficulty still remains that of distinguishing between the indications produced by real defects and those produced by harmless irregularities. A 200,000 volt X-ray will penetrate through about 70 mm. of steel whereas γ-rays of mesothorium will go through 150 mm. The X-rays, however, are more sensitive to slight variations in density of thinner material. An X-ray stereograph of a weld is shown. The change in lattice parameter of steel with stress is illustrated as well as the change in the width of the X-ray diffraction lines as a result of hardening and tempering and cold working. SE (5b)

X-Rays and the Welder. R. H. STEPHENS. *Electrical Review,* Vol. 112, Apr. 7, 1933, page 481. Discusses value of X-ray testing welds. MS (5b)

Tempering Effects in Quenched Copper-Aluminum Alloys (Die Anlasswirkungen in abgeschreckten Kupfer-Aluminiumlegierungen) W. STENZEL & J. WEERTS. *Metallwirtschaft,* Vol. 12, June 23, 1933, pages 353-356; June 30, 1933, pages 369-374. Most of the tests were made on Al-Cu alloy containing 4.28% Cu and made from very pure metals. The alloy was quenched in water from 530° C., then tempered at 20°, 75°, 150°, 225° and 300° from various lengths of time. The samples were examined by the X-ray diffraction method and tested for tensile properties and electrical resistance. The change in lattice constants during tempering at any temperature is much more rapid in the higher than the lower Cu alloys and with any Cu content much more rapid at higher than at lower tempering temperatures. As the tempering proceeds the diffraction lines become indistinct and then sharper as the process is completed. They regain their original sharpness only after tempering for a long time at 300° or higher. The precipitation of $CuAl_2$ does not take place in all crystals simultaneously. The changes in lattice constants, mechanical and electrical properties due to tempering at various temperatures are shown graphically. They indicate that the tempering process consists of two parts, a change in structure and a change in atomic distribution due to diffusion. At low temperatures changes occur only in the solid solution which assumes an "orderly" structure containing Cu rich areas. The electrical resistance is lowered and the yield point is raised without loss of ductility. At the intermediate stage of 225° the alloy is even slightly softer than the quenched alloy. The actual precipitation of $CuAl_2$ at higher temperatures is accompanied by changes in lattice constants and great loss of ductility, while the electrical resistance and yield point are lowered. As the tempering process is due to lattice changes and diffusion it is closely related to crystal recovery and recrystallization. 30 references. CEM (5b)

Growth of Metal Crystals in Metal Vapor II (Das Wachstum von Metallkristallen in Metalldampf) M. STRAUMANIS. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 19, Sept. 1932, pages 63-75. In order to check upon the theory of homöopolar crystal growth (Kossel-Stranski), sublimation tests on Zn at varying temperatures and pressures (H atmosphere) were carried out yielding the following results: If the H pressure is above 4 mm. Hg the formerly described relatively large hexagonal crystals form (See *Zeitschrift fur physikalische Chemie,* Abt. B, Vol. 13, Aug. 1931, pages 316-337.) Below 4 mm. Hg minute crystals of Zn form with the planes (0001), $(10\bar{1}0)$, $(10\bar{1}1)$ and $(11\bar{2}0)$. Individual crystals with more than 4 different types of planes did not occur. With the exception of $(10\bar{1}2)$ the types of crystals are in agreement with the theoretical statements of Stranski. The formation of perfect crystals is promoted by slow rates of growing, i.e. by volatilization of Zn at temperatures lower than the m.p. A dimorphous, regular form of Zn according to some authors, could not be verified even with crystals grown near the m.p. of Zn. The crystals are developing at some spot of the glass carrier without restricting themselves to a certain orientation of the hexagonal axis. If the sublimation is carried out in a high vacuum a deposit in a continuous layer occurs. Gray crystal powder at the colder parts of the sublimation tube is not present but always shows up at slow volatilization speeds or in the presence of gas. EF (5b)

Structure of Na-In and the Deformation of Atoms in Alloys (Über den Gitteraufbau von NaIn und die Deformation der Atome in Legierungen. 11. Mitteilung über Metalle und Legierungen) E. ZINTL & S. NEUMAYR. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 20, Mar. 1933, pages 272-275. The alloy NaIn is a homogeneous phase with NaTl structure and has the space lattice constant a = 7.297 A.U. Pure Na has a radius which is 15% larger than in this alloy thus yielding the greatest contraction of a baser atom so far established. It exhibits an appreciably changeable radius in analogous structure. A comparison between formerly established radii in NaTl structures shows that the contraction of base metals in alloys is the larger the bigger the base atoms themselves and the smaller their nobler "mates." Ion deformations and polarization of the alloy components show the same dependency. EF (5b)

Nature of Linkage and Lattice Types of Binary Magnesium Compounds (Bindungsart und Gitterbau binärer Magnesiumverbindungen. 12. Mitteilung über Metalle und Legierungen) E. ZINTL & E. HUSEMANN. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 20, Apr. 1933, pages 138-155. Power photograms of Mg_3Sb_2, Mg_3Bi_2, Mg_3P_2 and Mg_3As_2. Metallic conductivity of "non-metallic" structures. Boundary line between elements forming anions and metals in the periodic system and structure of Mg compounds. Anti-isomorphy of sesqui-oxides and compounds of the type Mg_3X_2. EF(5b)

Structures of Recrystallization of Duralumin. E. F. Bakhmetev. *Proceedings Aviation Materials Research Institute,* Vol. 1, 1933, pages 86-105 (In Russian). Relation between recrystallization produced by annealing and previous state of duralumin were investigated. Annealing at 520° C. fully recrystallizes the metal in all cases. With cold reduction less than 70% a non-oriented recrystallization is observed. A greater cold deformation produces recrystallization oriented differently than in cold rolled material. With high cold deformation (98.8%) 3 day annealing was not able to change oriented recrystallization into random arrangement. Specimens quenched or slowly cooled after annealing differ by the absence in the former of $CuAl_2$ lines on X-ray photographs. With a 40 second heating in nitrate bath a recrystallized structure with the same orientation as the cold rolled metal is produced. The influence of the original phase characteristics of the metal becomes less pronounced with the increased difference between the temperatures at which decomposition of solid solution ends and the recrystallization is completed. The maximum drop of strength corresponds to decomposition of the solid solution and is connected with the phenomena of recovery (Erholung) occurring without any recrystallization on heating to 300° C. Recrystallization alone causes but a slight drop in strength as can be seen by comparing duralumins annealed at 300° and 350° C. of which the first has its original structure and the latter is fully recrystallized. All conclusions were based on X-ray data. (5b)

Some Examples of X-ray Analysis of the Structure of Aluminum Alloys After Industrial "Hot" Working. E. F. Bakhmetev & G. F. Kosolapov. *Proceedings Aviation Materials Research Institute,* Vol. 1, 1933, pages 107-113 (In Russian). X-ray examination of several samples obtained from metallurgical plants showed that usual "hot working" produces X-ray patterns of metal deformed at cold working rate. The latter means a rate at which either the temperature is too low or the speed of deformation too high to permit the recrystallization to eliminate the effects of this deformation. (5b)

X-ray Determination of Residual Space Lattice Distortion in Pressed Duralumin. E. F. Bakhmetev & G. F. Kosolapov. *Proceedings Aviation Materials Research Institute,* Vol. 1, 1933, pages 74-85 (In Russian). Blurring of lines on Debye photographs taken from cold worked duralumin can be due either to fractionation of crystallites to smaller than 100 A.U. size or to distorted space lattice. By a series of experiments involving deformation and heat treatment it was shown that blurring of the lines was caused by space lattice distortion. Less than 30 seconds at 300° C. remove it, but 3 hours at 100° C. do not. (5b)

Some Remarks on the Mechanism of Structural Deformations in a Metal Depending on the Temperature, Speed and Rate of Deformation. E. F. Bakhmetev. *Proceedings Aviation Materials Research Institute,* Vol. 1, 1933, pages 114-121 (In Russian). Theoretical conclusions from the previous work, largely by the author. Deformation of crystals proceeds in steps, a period of actual deformation of slips is followed by a period of rest. In the slip planes atoms lose their place in the space lattice. During following pause primary crystallization of the metal can take place either by forming new crystallites or by joining the space lattice limiting the narrow area of the slip. The new formation can exist only when its surface energy is less than its internal energy. With lowering of the temperature of the body the temperature of the narrow slip plane drops rapidly. The surface energy of the new formation grows, and unless it had time to increase to the size when its internal energy is not less than its surface energy, its individual existence ends. For given conditions a certain definite number of atoms forming the new formation is required. Higher temperature of the body shortens the time required for the growth of the new formation until it becomes stable and decreases the number of atoms required for its stability. Speed of deformation shortens the periods of actual deformation and pauses between them decreasing the time available for recrystallization. (5b)

Revealing the Internal Secrets of Materials. *English Mechanics,* Vol. 14, July 7, 1933, pages 221-222. The possibilities of X-rays are shown by means of some radiographs referring to a sound and unsound oxy-acetylene welded joint on ⅜ in. and ½ in. plates respectively, to a light alloy automobile engine piston and to a portion of an airplane wing showing faulty joint. WH (5b)

Steel 4½ Inches Thick Examined with More Powerful X-Ray Equipment. *Steel,* Vol. 91, Sept. 5, 1932, page 29. Description of a new X-ray tube capable of operating continously at 300,000 volts for the examination of welded seams in pressure vessels and mercury boiler drums. The tube is 4 ft. long with an 8 in. bulb and is constructed of Pyrex glass ¼ in. in thickness. Tube and target are water cooled. JN (5b)

X-Ray Inspection of Welded Pressure Vessels. *Iron Age,* Vol. 130, Aug. 18, 1932, page 255, adv. sec. page 32. Describes X-ray machine installed for inspection of fusion welded drums and pressure vessels by the Henry Vogt Machine Co. The machine is a 345,000 volt cascade type designed to give maximum penetration, complete protection from X-ray beam and high-voltage and flexibility of operation. It was designed and built by Kelly-Koett Mfg. Co. to comply with requirements of American Society Mechanical Engineering code. VSP (5b)

On the Structure of Troostite. A. Glazunov. *Collection of Czechoslovak Chemical Communications,* Vol. 5, Feb. 1933, pages 76-83. From the work of many investigators it is seen that the crystallization centers from which the crystals of troostite grow are placed at the edges of what were formerly austenite grains, and also that a troostite rosette is composed of a great number of radial grains grown from the same crystallization center. The phenomenon, that crystallization proceeds in all directions from one single center, in the transformation of austenite into pearlite phases, is observed only at the maximal depth of supercooling along Ar_1 line. After a certain time, however, lamellae do appear in the troostitic rosette as a result of secondary recrystallization. The thickness of the lamellae is about 250 A.U. 21 references. GTM (5b)

On the Valency Electron Rule and the Atomic Radii of Base Metals in Alloys (Über die Valenzelektronenregel und die Atomradien unedler Metalle in Legierungen. 10. Mitteilung über Metalle und Legierungen) E. Zintl & G. Brauer. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 20, Mar. 1933, pages 245-271. 20 binary constitutional diagrams comprising alkaline and alkaline earth metals were studied by X-rays including the following systems: LiAg, LiHg, LiTl, MgTl, CaTl, SrTl, LiZn, LiCd, LiGa, LiIn, LiAu, LiSn, LiBi, BaTl, KTl, CaPb, SrPb, CePb, NaAg, CuAg. The β-brass structure was found in the first 6 systems, while the previously described NaTl phase occurred in the next 4 systems. Experimental evidence has been furnished that the Hume-Rothery law, according to which always 3 valency electrons occur with 2 atoms in body centered alloy phases, does not hold for alloys containing very base metals. In this case the ratio was found to vary between 1 and 5/2. Compiling the known atom distances of all body centered cubic alloys the writers show that the same base metals which do not fall in line with the valency electron rule, are also characterized by strongly reduced atomic distances due to a contraction of the less noble atoms. The X-ray data of the NaTl structural types yield that the distance reduction takes place at the expense of the baser component. The Li radius in LiZn for instance is 12% smaller than in the free metal. These dimensional changes indicate the polarization ability of base atoms. Larger differences in the polarization power of alloy components render the valency electron rule invalid. The solid solution formation of body centered structures was roughly studied in the miscible LiHg-LiTl system (β brass structures) while the powder photographs of the Li_2ZnCd and Li_2CdHg alloys showed the lines of LiZn (NaTl type) and LiCd (NaTl type) phase and LiCd (NaTl type) and LiHg (β brass type) respectively. EF (5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Percentage Elongation. A. C. Vivian. *Welder*, Vol. 4, Nov. 1932, pages 1-7. Besides tensile strength, percentage elongation is used as most important criterion of a structural steel; it is defined as ductile stretch up to the break point. It is shown that this is not an absolutely definite value as it depends entirely whether the strength of the material is calculated on the original section or the actual section at fracture. As the yield point stress must under no circumstances be exceeded if a structure is to remain stable the real factor of safety of a structure should be based on this stress. Tests were made to determine the load-extension relation of deposited weld metal for comparison with the load-extension relation of mild steel up to yield point. Percentage elongation is considered to provide a measure of ductility of steel; standardized bend or notched bar tests, however, are recommended in addition. Ha (6)

Stress Distribution in Cast Iron. Practical Use of the Form-Factor Method. A. C. Vivian. *Mechanical World & Engineering Record*, Vol. 93, Apr. 28, 1933, pages 402-405. Author has found that it is possible to analyse the stress distribution in cast-iron beams in a logical and consistent manner. The practical use of the form-factor method is explained in the article and the underlying formulae are derived. Kz (6)

Red Hardness of Cutting Alloys. W. A. Wissler. *Metal Progress*, Vol. 23, Mar. 1933, pages 49-50. Meaning of the term "red hardness," referred to in Sykes' description of a new cutting alloy in Feb. *Metal Progress*, is defined as the hardness of a metal measured while the sample is held at a temperature in the red range. It has no definite relation to cold hardness, but is usually less. "Hot hardness" is suggested as a better term. Fig. 3 in Sykes' article must be in error, inferring as it does, the hardness apparently measured cold is the "red hardness" of the samples tested. Sykes agrees the term should apply to hardness measured at the red temperature. The tests referred to were made at room temperature and meant to indicate that the high cold hardness resulting from precipitation hardening at 700° C. would indicate a relatively high "red hardness." WLC (6)

Research on Strength in Ship Building and the Conception of the Modulus of Elasticity. (Festigkeitsforschung im Schiffbau und der Begriff des Elastitätsmoduls E.) G. Wrobbel. *Schiffbau, Schiffahrt und Hafenbau*, Vol. 33, Nov. 15, 1932, pages 356-368. Statements mainly based on previous publications of C. von Bach, J. H. Biles, Pietzker, Dahlmann, Johow-Foerster, Foerster who take issue with the author, Lienau. Schnadel and Schadlofsky. The writer proves by bending tests on a structural steel employed in ship building (10 cm. wide, 100 cm. suspension and 10, 20, and 30 cm. high) that the modulus of elasticity is not constant since the conventional formula disregards the effect of shear. WH (6)

The Effect of Size of Specimen on the Strength and Elastic Properties of Cast Iron. A. H. Dierker. *Foundry Trade Journal*, Vol. 47, Dec. 22, 1932, page 379. Extended abstract of Engineering Experiment Station Bulletin No. 72 (Ohio State University Studies, Engineering Series). See *Metals & Alloys*, Vol. 4, Feb. 1933, page MA 36. OWE (6)

Samples and Test Methods for Cast Iron. (Les Epronvettes et les Methodes d' Essai des Fontes.). G. d'Ardigny. *Revue de Fonderie Moderne*, Vol. 26, Nov. 25, 1932, pages 427-429. Due to the fact that the mechanical properties of a casting vary at different points the Association of Belgian Founders developed some regulations for taking and preparing samples and for testing. In general, a sample piece cast separately from the same charge will do better than a piece taken from the actual casting. Bending test, impact test, hardness test and compression test under well defined conditions are described and recommended. Ha (6)

Local Deformations and Practical Methods to Measure Them. (L'Etude des Deformations Locales et les Méthodes Pratiques de sa Réalisation.) G. Ivanow. *Science et Industrie*, Vol. 16, July 1932, pages 287-291. Mechanical and electrical extensometers are dealt with. Examples of their use such as in measuring local deformations in static testing of chief member of the giant German sea plane Dornier Do-X are given. Engraver extensometer of the Ritz system and Huggenberger extensometer are described and their applications particularly on metallic members in aircraft construction are clearly shown. FR (6)

Shrinkage Melt to Cold Metal. Kotaro Honda. *Metal Progress*, Vol. 23, Apr. 1933, pages 50-51. Usual measurement of shrinkage by means of an extensometer built into the mold is thought unreliable. The writer and R. Kikuchi built an improved Turner type extensometer and determined that shrinkage measured by an extensometer is principally contraction after solidification. Total shrinkage of various metals was measured by the new instrument. The contraction after solidification was measured by the total dilatometer. The results and those of Endo and Matuyami results are summarized in a table. Total shrinkage is much greater than that obtained by an extensometer. WLC (6)

Determination of the Tensile Strength of Welded Joints. (Die Bestimmung der Zugfestigkeit geschweisster Verbindungen.) W. Hoffmann. *Die Elektroschweissung*, Vol. 4, May 1933, pages 87-88. After considering the suitable shape of tensile test bars for welded joints the stress distribution in notched bars is particularly referred to. It is shown that the rounded-off bars are suitable for the determination of the tensile strength as also the investigations by Jennings (*Journal American Welding Society*, April 1932, pages 37-42) proved. GN (6)

Simplification of Martens Extensometer. (Vereinfachung des Martensschen Spiegelgerätes.) E. Hesse & H. J. Wiester. *Zeitschrift Verein deutscher Ingenieure*, Vol. 76, Aug. 6, 1932, pages 785-786. The instrument used for tensile tests has been modified so that direct reading without telescopes is possible and more convenient connection with the specimen. Ha (6)

Fluctuations in the Results of Hardness Tests of Hardened Steels. (Schwankungen in den Ergebnissen der Härtemessung bei gehärteten Stählen.) O. Hengstenberg. *Stahl und Eisen*, Vol. 53, Apr. 6, 1933, pages 352-355. This work is an outcome of the controversy over the hardness fluctuations with time in hardened steel after magnetization, as reported by Herbert. Plots are shown of hundreds of Rockwell, Firth, and Scleroscope tests taken over periods of about 40 days on nitrided steels. Some fluctuations in hardness with time were obtained, but they are more probably due to errors in measurement. SE (6)

Studies of Cast Iron with a New Wear Testing Machine. (Untersuchungen an Gusseisen auf einer neuen Verschleissprüfmachine.) F. Heimes & E. Piwowarsky. *Archiv für das Eisenhüttenwesen*, Vol. 6, May 1933, pages 501-505. A machine is illustrated for making the following 4 types of wear tests. For measuring rolling friction a rod sample 25 mm. in diam. is placed between 3 rolls of 90 mm. diam. at 120° to each other rotating at about 1400 r.p.m.; load is applied through the top roll. For testing sliding friction a flat sample is pressed against the face of a rotating disk. The depth of cut with a medium hard rotating steel disk 1 mm. thick and 160 mm. diameter, and the wear of a sample rotated excentrically in a chamber filled with sand, are also measured. In all the 4 types of test the wear of different cast irons was greater the finer the graphite and the softer the iron. Pearlitic cast iron had better wear resistance than ferritic, although in rolling friction ferritic cast iron when alloyed with Ni, Cr, or Si, may show good wear resistance. In sliding friction graphite acts as a lubricant; however, since graphite also breaks up the structure there is an optimum graphite content. Cr, Si and Ni seem to have an effect only insofar as they influence the hardness. Phosphide and free cementite raise the wear resistance in sliding friction on steel; on cast-iron, however, they lower it because the rubbed-off particles have an abrasive action. SE (6)

Stress in Helical Seams of Closed Cylindrical Vessels. (Die Beanspruchung schraubenformiger Schweissnähte an geschlossenen zylindrischen Gefässen.) W. Dörscheidt. *Die Wärme*, Vol. 55, Sept. 24, 1932, pages 661-663. The stress in helical seams due to the pressure inside of cylindrical vessels is accounted for by a factor in the wall thickness formula. This factor has been computed for helical seams of various angles. The second part of the paper reports on pressure tests to fracture performed on a vessel provided with a zigzag seam. Tensile tests which yielded a larger strength of the seams than the parent metal could be corroborated. Fracture did not follow the zigzag course of the seam. However the crack is located within the region of the weld which is ascribed to its larger elongation values. EF (6)

Determination of Interior Stresses in Steel Cylinders from Stress-Time Curves. (Ermittlung von Eigenspannungen in Stahlzylindern aus Spannungs-Zeit-Kurven.) Herbert Buchholtz & Hans Bühler. *Archiv für das Eisenhüttenwesen*, Vol. 6, Dec. 1932, pages 253-256. See *Metals & Alloys*, Vol. 4, Feb. 1933, page MA 36. Ha (6)

Investigation of Thermal Effects in Duralumin During Its Impact Deformation. E. F. Bakhmetev & B. M. Rovinsky. *Proceedings Aviation Materials Research Institute*, Vol. 1, 1933, pages 61-73 (In Russian). Temperature changes in duralumin being deformed by impact were studied. A thermocouple was imbedded in the specimen. Temperatures were recorded with an Einthoven galvanometer supplied with a time recording arrangement. The temperature rises sharply during impact. With a 2 meter drop and 51% reduction of specimen height impact time is 0.005 sec., the temperature increases up to the moment when the tup leaves the specimen. This interval takes 0.01 sec., it then drops until the tup strikes again and then rises to a maximum within next 0.4 second. From these maximum temperatures and specific heat of the metal amounts of energy absorbed and evolved as free heat were calculated. About 77% of energy input was evolved as heat. Relation between the amount of energy consumed and deformation produced can be expressed approximately as a second degree curve. (6)

Chain-Cable and Anchor Testing Machine. *Iron & Coal Trades Review*, Vol. 125, Nov. 25, 1932, page 818. A new testing machine for chains and anchors of largest vessels and of 750 tons capacity is described in detail; overall length is 178½ ft., width 21 ft. and height 17 ft. The main cylinder is designed for a hydraulic pressure of 2 tons/in.². Ha (6)

On the Static Bending Test of Cast Iron. (Über die den statischen Biegeversuch an Gusseisen.) *Die Metallbörse*, Vol. 22, Nov. 12, 1932, page 1454. Note on experiments of Guillemeau, revealing that the static bending test does not necessarily furnish a clue for the evaluation of cast Fe. The measurement of the deformation of samples submitted to loads from 100-400 kg. is preferable. EF (6)

Finding Out What's What on the Pennsylvania Railroad. *Railway Engineering & Maintenance*, Jan. 1, 1933, pages 14-18. Describes facilities for and investigations on the maintenance of way materials. Laboratory and field tests. Rail abrasion, deflection and batter, rail defects and heat-treatment of rail ends, tie plate fastenings under test. WH (6)

On the Magnetization of Steel in the Alternating Field. Yukichi Asakawa, Takao Tsuda & Mitsunaga Honma. *Journal of the Society of Mechanical Engineers*, Japan, Vol. 36, May 1933, pages 326-331. Paper read before the 222nd Meeting of the Society of Mechanical Engineers, Japan, Oct. 28, 1932. Experiments were carried out to find the change of magnetic properties of various steels caused by the heat treatment in the alternating field. The magnetic induction and the wave form of the secondary circuit were measured. The change of wave form was studied by means of the harmonic analyser. The authors compare the results of their experiments with other properties of steel. Kz (6)

Fatigue of Metals & Alloys (6f)

Influence of Corrosion on Torsional Endurance Limit of Steel and Non-Ferrous Alloys. (Der Einfluss der Korrosion auf die Drehschwingungsfestigkeit von Stählen und Nichteisenmetallen.) T. DUSOLD. *Mitteilungen des Wöhler-Instituts,* No.
1 14, 1933. Published by N. E. M. Verlag, Berlin. 89 pages, 36 figures, 13 references. Actual endurance limits were not obtained, only comparative results being sought. For each material an initial stress was selected, the specimen run only 2 million cycles (even for aluminum alloys), the stress raised 10%, another 2 million cycles run, and so on till the specimen failed. By comparison with the behavior of a reference specimen run under this procedure, with that of specimens that had been worked between rollers so as to compress the surface, and of specimens both compressed and uncompressed run in an aerated water stream to produce corrosion, or in the water stream under an impressed voltage with a zinc anode, to make the specimen cathodic, the effect of these variables was appraised. A soft 50,000 lbs./in.^{2} tensile carbon steel, one of 18 Cr, 9 Ni, 0.12% C, a nitrided steel of 1 Cr, 1 Al, 0.2 Mo, 0.30 C, a 3% Ni, 0.30 C
2 steel, and a quenched and tempered 4¼ Ni, 1¼ Cr, 0.9 W, 0.30 C steel, commercial nickel, and four alloys were studied. One Al alloy contained 5.6 Cu, 0.7 Mn, one 10 Zn, one 0.7 Mn, 0.7 Mg, 1 Si and the last the peculiar composition of 10 Zn, ½ Cr, 1.8 Si and 1.3 Pb. In general, the material worked on the surface by the rolling process showed longer life than those not worked. The high stress finally used on the 18 Cr, 9 Ni steel caused the specimen to heat up so that useful comparisons of the compressed material or of specimens run in water can hardly be made. Nickel was not injured by the water. Since it was too hard for the surface to be cold worked by the rolling process, and since it resisted corrosion, the nitrided steel acted similarly in all the tests. In the other cases the effect of working the surfaces, of corrosion by water or of protection by a zinc anode was
3 about what would normally be expected. Damping tests were made on the materials studied. As only comparative results were sought, the torsional fatigue limits or corrosion fatigue limits cannot be tabulated and the whole investigation leads to qualitative ideas of the behavior of the alloys rather than to quantitative data that can be expressed without reciting every detail of every experiment. HWG (6f)

Endurance of Boiler Steels and the effect of Chemical Action. (Ermüdungsfestigkeit von Kesselbaustoffen und ihre Beeinflussung durch chemische Einwirkung.) CL. HOLZHAUER. VDI Verlag, Berlin, 1933. Paper, 6x8½ inches, 73 pages. Price 6.50 RM. *Mitteilungen der Materialprüfungsanstalt an der Technischen Hochschule Darmstadt,* No. 3, 1933, 73 pages. Inasmuch as boiler service involves repeated, not completely reversed stress, the presence of notches, elevated
4 temperature and the presence of chemical action, all these were provided for in the experimental set-up. Some preliminary tests were made on a (rimmed) practically Si-free boiler steel, but most of the tests were on a killed steel of 0.125 (.15) C; 0.53 (0.63) Mn; 0.09 (0.13) Si; 0.016 (0.016) P; 0.025 (0.032) S (first figures average of whole cross section, those in parenthesis, on the core). The steel also contained 0.15 Cu. The samples were from ¾ in. thick boiler plate that had been annealed 1 hour at 920°C. The static properties were, for the whole cross section and for the core, tensile 59,000 and 56,500 lbs./in.^{2}, yield 33,500 and 41,000 lbs./in.^{2}, elongation 30%. Impact in mkg./cm^2, usual specimen 18.0, small specimen (5 x 10 mm^2) as received 10.8, normalized 11.7 artificially aged (details not given) 1.4. Endurance, regular specimen, repeated bending, room
5 temperature 33,500 lbs./in.^{2}, same with notched specimen 30° notch, 0.05 mm, radius at base, bar 10 mm. diameter, notched to 6 mm. diameter, 23,500 lbs./in.^{2}.

The notched specimen in completely reversed tension-compression endurance test gave 15,700 lbs./in.^{2} on the Schenck machine at 280 cycles/minute at room temperature. With initial tension of 7400 lbs./in.^{2} the upper limit of the fatigue range, for the notched bar, at room temperature was 29,500 lbs./in.^{2} in air, and the same in air at 275°C. The axial loading endurance machine was then provided with an electrically heated enclosure about the specimen so it could be subjected to various liquids at temperatures of superheated steam, a regulating manometer being used.

Using all the while the notched bar with 7400 lbs./in.^{2} initial tension (lower limit), the following results were obtained at 275°C. 60 Atm. pressure for the
6 upper limit. Water 28,700 lbs./in.^{2} NaOH 0.7 g/l 32,000 lbs./in.^{2}, Na_3PO_4 6.7g/l 30,500 lbs./in.^{2}, NaOH 50 g/l 29,000 lbs./in.^{2}, Na_3PO_4 50 g/l 32,700 lbs./in.^{2}. At 87.5 atm. pressure in NaOH 280 g/l the figure was 25,500 lbs./in.^{2}. (Another lot of 0.10 C rimmed steel (Si trace) under 87.5 atm. pressure, 275°C., in NaOH at 280 g/l gave 22,000 lbs./in.^{2}).

Not only did the endurance limits improve slightly over the air figure in weak NaOH or Na_3PO_4, and still more in the stronger Na_3PO_4 and drop slightly in water and 50 g/l NaOH and markedly in the strong NaOH, but the S-N curves differed. Those showing a corrosive effect (lowering of endurance limit) showed the knee in the S-N curve at an extraordinarily small number of cycles. Failure ensued in less than 50,000 cycles at stresses only a tiny bit above the endurance limit
7 in the corrosive NaOH solutions, while in the protective, weak NaOH solutions and the Na_3PO_4 solutions, the knee came at about 500,000 cycles.

The cracks produced were studied metallographically. The formation of cracks depends on the strength of the corroding medium. Intercrystalline cracks occur in the presence of passivating media and sufficiently high repeated stress, while in the corroding media, the cracks are like those caused by high repeated stress alone, only they are eaten out broader. H. W. Gillett + GN (6f) -B-

Corrosion During Alternating Stresses (Korrosion bei Wechselbeanspruchungen) *Zeitschrift für Flugtechnik und Motorluftschiffahrt,* Vol. 23, Dec. 28, 1932, page 737. Tests were carried out using as a corroding medium tap-water containing 285 g./t. impurities. After only 1,142,000 reversals more than
8 1000 small cracks per mm.^{2} appeared, uniting to larger ones during the progress of the test, but no fatigue cracks were branching out of them. The cracks had no connection with stress-lines or with the direction of flow but probably depend on inclusions in the material. Before rupture, cracks formed parallel to the glide planes especially in the zone of greatest shear stress. Kz (6f)

Static and Dynamic Properties of Light Alloys Poured in Sand Molds (Propieta statiche e dinamiche delle leghe leggere colate in terra) W. SARAN. *Alluminio,* Vol. 1, Nov.-Dec. 1932, pages 368-376. Brinell hardness, elastic limit at 0.001, 0.01, and at 0.2% permanent set, tensile strength, modulus of elasticity and torsion, and fatigue due to repeated elongation, flexing, and torsion, were
9 studied for most important light alloys having following composition:

Alloy	Zn	Cu	Fe	Si	Mn	Mg	Sb	Al
German	11.84%	2.0	0.71	0.26	......	......	......	Bal.
American	0.28	5.78	0.75	0.47	......	0.08	......	Bal.
Piston	......	14.40	0.38	0.23	......	......	......	Bal.
Silumin	......	......	0.48	11.79	......	......	......	Bal.
K. S. Seewasser	......	......	0.51	0.56	3.60	0.44	0.1	Bal.
Lautal L IV	0.09	4.70	0.51	2.47	0.015	0.01	......	Bal.
Alufont (duro)	11.86	2.23	1.52	0.21	......	0.23	......	Bal.
Elektron A Z G	2.40	0.08	trace	0.19	......	Bal.	......	5.30

10 Conclusions drawn from data are: that light alloys do not show the same differences in dynamic properties as in their static properties; fatigue strengths cannot be measured by accelerated tests. Calculation of fatigue from static data also impossible; no relation between elastic limit and fatigue strength; fatigue strength can only be determined by Wöhler method; heat treatment improves static, but not dynamic properties. AWC (6f)

ELECTROCHEMISTRY (7)

The Influence of High Frequency Currents on Polarized Electrodes. S. GLASSTONE & G. D. REYNOLDS. *Transactions Faraday Society,* Vol. 28, July 1932, pages 582-596; Vol. 29, Feb. 1933, pages 399-409. Using a thermionic valve oscillator with a constant frequency of 10^6 cycles/sec. (variations from 0.1-2 x 10^6 cycles/sec. having no effect on results) and small "point" test electrodes of platinum wire as cathode of polarized cell and a Pt wire spiral as other electrode it was found that unless the high frequency current density exceeded 2.5 milli-amp./mm.^{2} there was no high frequency effect which is the reduction of electrode potential at a given polarizing current density resulting from the application of a given high frequency current, but above this current density the high frequency effect increased linearly as the high frequency current. At high polarizing currents high frequency effect was small and independent of gas (air, O_2, H_2, N_2) passed into electrolyte: as the pH increased the high frequency effect increased up to 6.8, decreased slightly at pH 9.4, and increased again at pH 13. Added salts reduced the high frequency effect. At low polarizing current densities the high frequency effect was not independent of the nature of the gas, being small with N_2 and H_2, and very large with air and O_2, and was limited by the "standing" potential of electrode in the absence of any current. The high frequency oscillations have no influence on the minimum overvoltage for H_2 evolution but affect the value of the residual current. The high frequency effect on limiting current is proportional to the square root of power expended in solute per unit area of electrode surface. The high frequency effect is brought about by mechanical disturbance in electrolyte such as oscillatory rotation of molecular dipoles constituting water as solvent. PRK (7)

Electroplating (7a)

Studies on the Electrodeposition of Zinc. (Report I). Y. OGAWA. *Journal Mining Institute of Japan,* Vol. 48, No. 572, Dec. 1932, pages 1289-1296. Author began with electrolysis of pure solutions, using platinum anodes in order to get rid of effects of Pb which is usually neglected. Influence of the rise in temperature was studied as well as those of the variations in the composition of the electrolyte, current density and speed of agitation. Current efficiency was found to increase with rising temperature (between 30° and 80° C.) both for the current density of 3 and 12 amp./dm.^{2}. Where the impurities are absent, the cause of the lowering of the current efficiency should be sought in the simultaneous discharging of H' ions with Zn'', but not in the so-called chemical corrosion of the Zn already deposited. The phenomena observed were explained from this standpoint. Yo (7a)

Cadmium Plating and Galvanizing of Aluminum and Duralumin. (Kadmieren und Verzinken von Aluminium und Duraluminium.) *Zeitschrift für Flugtechnik und Motorluftschiffahrt,* Vol. 23, Nov. 14, 1932, page 650. Cd plating and galvanizing of Al and duralumin provide a good corrosion resisting coating, even against sea water. A Cd coating of 1/80 mm. thickness weighs 0.23 kg./m.^{2} i.e. not more than a lacquer coating. Particulars concerning the treatment of the metal before plating and methods of plating to secure a non-scaling Cd coating are given. Kz (7a)

Cadmium Plating Instead of Tinning Prior to Soldering. (Kadmium-plattierung anstatt Verzinnung vor der Lötung.) *Der Maschinenmarkt,* Vol. 38, Jan. 11, 1933, page 10. It was found that solders spread more uniformly and smoother on Cd plated pieces. Common resin is used as flux. With low current density, a deposit of .0075 mm. is obtained within 20-30 minutes. Durability of a Cd layer is much superior to Ni and Sn plated parts. The easy and quick handling is also of importance for the shop practice. RFV (7a)

Barrel Plating with Particular Reference to Optimum Loads and Costs. GUSTAF SODERBERG. *Quarterly Review, American Electroplaters' Society,* Vol. 10, Apr. 1933, pages 8-9. Paper read at Philadelphia Convention of American Electroplaters' Society, July 1932. Two problems in barrel plating are: (1) To control the average thickness of deposit in a barrel-load, and (2) to obtain the same thickness of deposit on all pieces that make up a barrel-load. Average thickness in a barrel-load may be controlled by regulating the current density and time of plating, with proper allowance for "barrel efficiency." Barrel efficiency is the net cathode current efficiency on the articles inside the barrel, and is to be determined in each case experimentally. Cathode surface and current density in the barrel are important factors which must be ascertained in each case. Cathode surface may be determined by actual measurement and current density may be based on the assumption that one-third of the total cathode surface in the barrel is being plated at any one time. An expedient way of obtaining the nearest to the same thickness of deposit on all articles plated in a barrel is to standardize on the amount of cathode surface to be admitted into the barrel per load, i.e., 40 ft.^{2} to each 30-inch barrel. Tables of surface areas of bolts and nuts, and cost estimating methods are also given. LCP (7a)

Testing of Copper Plating Baths. (Untersuchung von galvanischen Kupferbädern.) T. HAMBURGER. *Zeitung für Deutschlands Buchdrucker,* Vol. 44, Aug. 2, 1932, pages 523-524. After diluting the liquid sample, H_2SO_4 can be directly determined by titrating with NaOH. The $CuSO_4$ content is found by determining the density and subtracting the density corresponding to the H_2SO_4 content (table). A contraction factor of 1.0015 is also subtracted. EF (7a)

The Accuracy of Electrotyping Reproduction. J. HOMER WINKLER. *Printing Equipment Engineer,* Vol. 46, June 1933, pages 17, 42. Author refers to investigations of Blum and Rawdon, and Graham on the influence of the crystalline structure of the base metal upon that of the electrodeposited metal. The author asserts that the electrolytic reproduction of a relief printing plate is far more accurate than required. Kz (7a)

Deposition of Copper in Solutions from Complex Copper Halogen Salts. (Sur le Mecanisme du Depot du Cuivre dans les Solutions d'Halogenures Cuivreux Complexes.) N. THON & J. PINILLA. *Journal de Chimie Physique,* Vol. 20, Feb. 25, 1932, pages 71-76. Describes experiments to study cathodic processes in electrolysis in Cu halogen salts, namely chlorides, bromides, and iodides. The study is a mathematical one and includes many formulae and graphs. MAB (7a)

Electro-deposition in Printing. *Electrical Review,* Vol. 112, Jan. 27, 1933, page 114. Ni plating of flat printing surfaces gives a much harder facing than Cu or stereo metal. Life of ordinary printing plate is 20,000-40,000 impressions; when Ni plated about 1,000,000 impressions may be obtained. Ni facing insures correct tone in reds, the brilliancy of which is lost through chemical action by printing from Cu surfaces. If plates other than Cu are to be Ni faced they must first receive a coating of Cu. For excessive runs the plates are faced with Cr, enabling an indefinite number of impressions to be run without loss of definition. Cr plating is perfect for color work, as there is no change in the tone value of inks of any manufacture. Cylinders for rotary printing are Cu plated either by total or by partial immersion in the bath. Modern process gives a deposit with a close grain and very smooth surface. For heavy fast-running presses, cylinders are given a final coating of Cr. MS (7a)

Electrodeposition of Alloys from Metal Cyanides in Cyanide Solution. (Galvanische Abscheidung von Legierungen aus Metallcyaniden in Cyanidlösung.) KOSAKU MASAKI. *Bulletin of the Chemical Society of Japan,* Vol. 7, May 1932, pages 158-168. The potentials of metal-cyanides in alkali cyanide solution were investigated. Employing the data on the single potentials obtained, the author determined the optimum conditions for the electro-deposition of alloys, which were successfully carried out. Experiments are discussed and results presented in graphical and tabular form. Kz (7a)

Questions of Modern Nickelplating. (Fragen der modernen Vernicklung.) *Oberflächentechnik,* Vol. 9, Dec. 20, 1932, pages 255-257. Methods of testing for corrosion resistance (salt-spray test), hardness of deposits, usually 155-420 Brinell, depending on kind of bath, acidity of baths, normal pH value, usually 5.2-5.8, rapid nickeling baths, throwing power of baths, pitting and other defects of deposits are discussed; influence of proper choice of anode is pointed out. Ha (7a)

On Nickel Anodes. (Über Nickelanoden.) E. BECKER. *Die Metallbörse,* Vol. 22, Oct. 8, 1932, pages 1293-1294; Oct. 15, 1932, pages 1325-1326. Deals with nature of Ni anodes, i.e. their composition, form and method of preparation with reference to their solubility. In Germany anodes of 98-99.5% Ni are widely used to counteract the detrimental effect of contaminations. The use of more expensive but purer anodes is also more economical. The effect of Cu, Fe, Si, As, S and C in Ni anodes is discussed. There is a tendency in highly pure anodes towards passification. Low amounts of 0 and/or S promote solubility which is favored by $Ni\text{-}Cl_2 \cdot 6H_2O$ at least 25 g./l. of electrolyte. The absence of alkalies after fat removal must be ascertained, (pH = 5.0-5.8). New anodes are first introduced in the sand blasted state, old ones are washed and then placed into a weak H_2SO_4 solution (5:100) for one night. The form of the anodes must be adjusted to the object to be Ni-plated. Recent tendencies are discussed critically. Difficulties involved in casting Ni anodes are pointed out. Graphite crucibles of 50 kg. capacity with clay lining and a cover of NaCl, glass, gypsum or fluorspar and deoxidation with Mn or Mn-phosphate are recommended. The latter is introduced by a cast iron bell provided with holes. The precautions during casting are given. Cast anodes are less suited for modern rapid Ni plating processes for which rolled anodes are preferable, the solubility of which however is liable to vary. A combination of both anodes is therefore often employed. To avoid the use of 2 kinds of anodes, hammered Ni anodes are recently introduced with success. Cast anodes are carefully annealed in muffle furnaces and then forged. Irregular results are met with when employing Ni anodes made by electro-deposition. The I. G. Farbenindustrie patented anodes are sintered in a hydrogen current. The Ni powder is secured from reduced Ni-carbonyl. EF (7a)

Ultra-Rapid Nickel-Plating in France. MARCEL BALLAY. *Metal Industry,* London, Vol. 41, Nov. 18, 1932, pages 499-500. Good commercial results are produced with a hot sulphate bath operated with a high current desity up to 10 amp./dm^2. The articles should be pickled in a hot ferric chloride solution, this being good also for Ni-plating on Al and Al-alloys. For plating of Zn or die-cast alloys, the Ni bath should contain Na_2SO_4 and Na citrate. Ha (7a)

Nickel Plating of Fabricated Zinc in a Barrel. ALBERT HIRSCH. *Transactions Electrochemical Society,* Vol. 63, May 1933, pages 135-140; *Metal Cleaning & Finishing,* Vol. 5, July 1933, page 299. Procedure followed by the author in Ni plating small Zn parts is described as follows: (1) dry grinding in sawdust and pumice, (2) cleansing in a mild alkaline solution, (3) half-hour Cu plating in cyanide bath in a barrel, (4) 20-minute ball burnishing and, (5) one hour Ni plating in barrel with a solution having a pH of 7.6 to 8.0. LCP (7a)

The Electrodeposition of Palladium. R. H. ATKINSON & A. R. RAPER. *Preprint, Electrodepositors' Technical Society,* London, Vol. 10, Apr. 1933, pages 1-19. Includes 20 references. The development of Pd plating was traced back to Smee in 1841. The soluble anode process by Keitel and Zschiegner (U. S. Pat. 1,779,436 and 1,779,457, 1930) using $Na_2Pd(NO_2)_4$ and the diaphragm process by the author were described in detail. In the latter process, the catholyte contains $Pd(NH_3)_2Cl_2$, 40 g./l., Conc. NH_4OH, 35 cc/l., NH_4Cl, 10 g./l. The anolyte contains $(NH_4)_2CO_3$, 10 g./l. $(NH_4)_2$ SO_4, 20 g./l. conc. NH_4OH, 50 cc/l. Porous tiles are used for the diaphragms. Anodes may be Pb. Cathode efficiency 93 to 100%. Current density 0.1 to 2 amp./dm^2. Lower temperature favors bright deposit. pH ranges 9 to 10. A non-porous deposit of Pd requires 0.0002 inch in thickness. Other properties of Pd, methods of analysis of electrolytes and method of stripping Pd deposit are also given. LCP (7a)

Rhodium Plating. COLIN G. FINK & GEORGE C. LAMBROS. *Transactions Electrochemical Society,* Vol. 63, May 1933, pages 181-186; *Metal Industry,* New York, Vol. 31, June 1933, pages 208-209. Includes 16 references. Authors prepared their Rh bath by first alloying the Rh with Pb and Bi and then treating the regulus with acids and alkali, resulting in $Rh(OH)_3H_2O$. This salt is then dissolved in a H_2SO_4 and $(NH_4)_2SO_4$ solution to make up the bath. This bath works better and is more efficient than any other Rh plating bath now known. The operating conditions set forth are a temperature not less than 50° C. and a current density not over 0.6 amps./in.^{2}. LCP (7a)

The Electrodeposition of Tungsten from Aqueous Alkaline Solutions. M. LESLIE HOLT & LOUIS KAHLENBERG. *Quarterly Review, American Electroplaters Society,* Vol. 19, Jan. 1933, pages 41-52; *Metal Industry,* New York, Vol. 31, Mar. 1933, pages 94-97. Includes 33 references. An alkaline solution containing 100 grams $Na_3PO_4 \cdot 12H_2O$, 30 grams WO_3, in a total volume of 150 cc. was found to give the best results. At a temperature of 90° C. nice silvery deposits weighing between 0.02 and 0.03 g./dm.^{2} of cathode area were obtained in 20 minutes through a wide range in current density, the best being 10 amp./dm.^{2}. Satisfactory deposits were obtained only on brass, Cu or chromium-steel cathodes. PRK (7a)

Significance of Bath Temperature of Chromium Plating Solutions. (Die Bedeutung der Badtemperatur bei Chromelektrolyten.) E. WERNER. *Die Metallbörse,* Vol. 23, Feb. 25, 1933, pages 241-242; Mar. 18, 1933, pages 350-351. After stressing optimum addition of 0.8% SO_4 to the Cr plating bath, Werner criticizes omission of bath temperature in literature. A bath yielding perfect results at 20° might fail entirely at 45° C. which effect is ascribed to the foreign acid additions. A plating solution operating well at 45° C. can be used at 17° C. if the foreign acid content is raised to 1.5%. Cr deposits obtained at low temperatures are harder than those gained at higher temperatures due to H absorption. A plating solution of 10 l. H_2O, 2.1 kg. chromic acid, 2.2 g. phenolic acid, 5 g. oxalic acid, 20 g. Cr sulphate yielded nothing but yellow deposits at 4.4 volts and 10 amps./dm.^{2}. After adding 10 g. sodium fluosilicate perfect deposits were quickly secured at 30-50° C. and 5 volts. A fresh bath of 10 l. H_2O, 2.1 kg. chromic acid, 10 g. tungstic acid, 21 g. oxalic acid, 10 g. Na-bisulphite, 10 g. NaF_2 shows 8 volts. After brushing the Pb anodes the voltage drops to 5 volts and current density to 20 amps./dm.^{2}. Splendid deposits are obtained in 2 min. at 50° C. If the bath is not continuously in use, brushing of the Pb anodes is indispensable. The effect of phenolic acid is shown in that an electrolyte comprising 10 l. water, 2.2 kg. chromic acid, 22 g. Cr sulphate, yielding bright coatings at 35° C. and 3.9 volts but failing on addition of 5 g. oxalic acid, was restored to good condition by adding 10 g. phenolic acid. Plating solutions with 500 g./l. CrO_3 and a catalyst up to 1% of a fluosilicate work satisfactorily up to 70° C. (5 volts). Further tests indicated acetic acid, Al sulphate, phosphates, heavy metal sulphates and chlorides promoted the Cr deposition if the proper bath temperature has been observed, no influence of the anode material (Fe, Ni, Nirosta, Cr, ferro-chromium, Pb) could be noticed. Best suited anodes are made up by 2/3 Cr + 1/3 Pb. Fe is also suitable. The activity of Pb anodes can be preserved by addition of 0.001% Hg chloride with reference to the CrO_3 present. EF (7a)

Saving Expensive Parts by Electro-deposition. A. EYLES. *Mechanical World & Engineering Record,* Vol. 91, Mar. 25, 1932, pages 287-288. The deposition of Cr on expensive worn parts not only saves replacement, but provides a hard and very smooth surface which shows excellent wearing properties. Where the margin of strength is small, this method has the added advantage that the strength of the repaired part is not reduced as it is when resort is made to machining. Kz (7a)

INDUSTRIAL USES & APPLICATIONS (9)

The March of Platinum in Industry. Edmund M. Wise. *Metal Progress,* Vol. 23, Apr. 1933, pages 36-40. The discovery, development and use of Pt are recounted. Present day industrial and scientific applications of Pt and its alloys are related. The sources and price range of Pt are also given. WLC (9)

Ten Years' Progress in Copper-Nickel Condenser Tubes. Robert Worthington. *Marine Engineering & Shipping Age,* Vol. 38, July 1933, pages 266-267. General review. Kz (9)

Casting Experience of Monotype Vitalloy 160. Wilson S. Yerger. *Printing Equipment Engineer,* Vol. 46, June 1933, page 30. Deals with research work done to find a metal which would cast at lower temperature and give more perfect printing face. No analysis is given. Kz (9)

Application of Tungsten Wire in the Electrical Industry and Principles of Its Heat Treatment. N. M. Zarubin & A. N. Koptzik. *Tzvetnuie Metallui,* Feb. 1932, pages 189-204. Recent progress in manufacture and heat treatment of W wire is reviewed. An apparatus and method for measuring sag in W wire are described. Heat treating experiments are described for controlling grain size of wires with addition of K_2O, SiO_2 and ThO_2. Photomicrographs and bibliography are given. BND (9)

Compound Steel Rails. (Schienen aus Verbundstahl.) R. Spiess. *Verkehrstechnik,* Vol. 50, Mar. 20, 1933, pages 143-144. "Verbundschienen" consist of 2 different steels joined in the molten state in such a manner that the upper flange comprises the harder steel. The object is to combat excessive wear due to increasing traffic stresses. The advantages are fully dealt with in the introduction. The rail placed on the market by the Vereinigte Stahlwerke shows 110-130 kg./mm.^{2} tensile strength in the upper flange and 45-65 kg./mm.^{2} for the rest of the rail. The harder steel is first poured into a mold of about 22 tons capacity. After solidification of the surface, a partition wall is removed and the softer steel is poured in. Macro-structural illustrations disclose the distribution of both kinds of steel and furthermore the successful joining of these rails by three different fusion methods. The latest advances of design and the welding possibilities are reviewed. Data on impact tests are tabulated which reveal that no separation of the hard and soft component takes place due to the intimate contact secured by joining both steels in the liquid or semi-liquid state. Compression and torsion tests confirmed the results of the impact tests. WH (9)

Light Metal Pistons for Diesel Engine Vehicles. (Leichtmetallkolben für Dieselkraftwagen.) O. Steinitz. *Deutsche Motorzeitschrift,* Vol. 9, Nov. 1932, pages 214-216. Gray cast iron pistons which maintained their predominant place in Diesel engines were recently challenged by light metal ones particularly after the development of high speed Diesel engines. The various light metal pistons on the German market are touched upon. EF (9)

Data on Some Special Steels for Machine Gun Barrels. V. V. de Sveshnikoff. *Transactions American Society for Steel Treating,* Vol. 21, July 1933, pages 652-662. 1 reference. Various alloy steels tested in comparison with the world war standard machine gun barrel are recorded in their physical properties, analyses, heat treatment, and accuracy and erosion cracking on firing to destruction. The firing tests, macroscopic and microscopic examination are described. Accuracy of firing and velocity tests are tabulated for various numbers of rounds fired. Stainless and Mn-Ni steels were found superior to the standard barrel in use at the start of the tests 10 years ago. Cr-V steels performed nearly as well. Performance in firing tests of the various steels is described. WLC (9)

Special Bearing Metals. (Speziallagermetalle.) Edmund Richard Thews. *Werkzeugmaschine,* Vol. 37, June 15, 1933, pages 220-221; June 30, 1933, pages 236-237. Author endeavors to give comprehensive survey in alphabetical order of bearing metals that became known in world's literature. Compositions are given. GN (9)

Copper Roofs. (Les Toitures en Cuivre.) *Cuivre et Laiton,* Vol. 5, Dec. 15, 1932, pages 549-562. This installment describes and gives many constructive details of gutters, drain pipes and their accessories. Copper ornaments and modes of fastening on roofs, cupolas, etc., are described. Ha (9)

Polished Steel Tube Furniture. *Gas Engineer,* Vol. 57, June 1932, page 294. Polished Cr plated steel tubing combined in artistic fashion with glass, cane, wood, leather and cloth upholstery. The advantages as compared with wood are no cleaning or polishing is required, greater strength although lighter, resistance against roughest treatment, fire proof and hygienic qualities. The weldless steel tubing discussed is made from small circular steel billets. WH (9)

Modern Developments in Steel Furniture and Equipment. *Gas Engineer,* Vol. 57, May 1932, page 265. Saving of floor space effected by steel partitions, fire resistance, ease of erecting and dismantling, clean-cut directness of design, excellence of finish and increased durability of furniture made of steel are claimed. WH (9)

Press Pistons. (Pistons de Presses à Plomb.) *La Fonte,* Vol. 2, July 1932, pages 173-174. Heavy cast iron pistons have to be sound and strong. A change in the design of the castings is advocated in order to have regular thickness throughout the casting. Composition proposed for cast iron to be poured is as follows: Total C 2.8-3.2, Si 1.2-1.4, Mn 0.6-0.8, P $<$ 0.4, S $<$ 0.08. FR (9)

Cast Iron for Caustic Soda Troughs. (Fontes pour Cuves devant Contenir de la Soude Caustique.) *La Fonte,* Vol. 2, July 1932, page 175. A low Si content is to be aimed at. Furthermore, according to the work of Piwowarsky and Kötschke, a low Ni addition (about 0.6%) is of interest to improve the corrosion resistance of cast iron against caustic soda. FR (9)

Steel for Shipbuilding Purposes. *Journal of Commerce (Shipbuilding and Engineering Edition),* Jan. 19, 1933, pages 1-2. Discussion on higher quality steels used for upper structures of ships deals with selection of steels according to their "limit of proportionality" and states that, where such a value is not specified, larger proportion of steel used for such purposes still has a "limit of proportionality" of less than 10 tons/in.^{2} In British practice where a "limit of proportionality" of 15 tons/in.^{2} is specified, a reduction of scantlings of 10% is allowed. American designers have suggested the use of a Ni steel with a "limit of proportionality" of 18 tons/in.^{2} for bottom, side shell, and deck plating material, and propose to accept a working stress of 12½ tons/in.^{2} with such material. JWD (9)

Steel-Type Diesel. *Marine Engineering & Shipping Age,* Vol. 38, Mar. 1933, pages 101-102. Description of a new Winton marine Diesel, in which main structural units are of welded steel-plate construction, which was adopted because it provides an engine of relative lighter weight, exceptional strength and rigidity. Reduction of approximately 25% in weight per h.-p. was achieved. Crank case and cylinder block are built in one piece of welded steel-plate construction. Tie-bolts are made of special high-grade electric furnace steel (tensile strength—135,000 lbs./in.^{2}). Cylinder liners are of Cr-Ni-iron machined on both sides. Crankshaft is of Cr-Ni-steel. Cylinder heads are made of Cr-Ni-iron and the pistons of Ni-Cu-Al alloy. For the valves special silchrome alloy steel is used. The camshaft, of high C steel, is of the built-up type with 2 sets of cams, which are of Mo steel, drop forged and hardened. Kz (9)

The Selection of Worm-Gearing. W. Arling. *Mechanical World & Engineering Record,* Vol. 92, Sept. 9, 1932, pages 248-250. After discussing the question from the mechanical engineer's viewpoint it is said that the working surface of the worm-thread must be very hard to resist wear, and smooth to reduce friction. Experience has shown that the best material is case hardened steel with about 3½% Ni, which gives a hard-wearing surface in conjunction with high core strength. The wheel must be made from P-bronze alloy, centrifugally cast to improve density and resistance to crushing, and must be produced under strict metallurgical control, since the load capacity of bronze is sensitive to slight variations in composition or casting conditions. Kz (9)

Tin Dredge Mechanical Practice. W. L. Stevenson. *Mechanical World & Engineering Record,* Vol. 93, Mar. 24, 1933, pages 293-295. The exceptionally severe working conditions in tin dredging provide a full-scale test for materials. Early bottom tumblers were made of cast iron, which were replaced by C steel castings and later wearing plates of Mn steel were bolted or riveted to the digging face. Recent developments include solid castings of Mn steel, or renewable treads of this material bolted to cast-steel or cast-iron centers. Buckets are now made from Mn-steel with a renewable lip riveted to it. Pins are usually made of Ni alloy steels, and may be hardened. Top tumblers have bodies of toughened cast steel and renewable wearing plates of Mn steel. Shafts are made from special Ni steel alloy. The carbon steel contains 0.40-0.60% C, the maximum strength being 43-47 tons/in.^{2}, elongation 16%. Mn steel contains 12-13% Mn and 1.1-1.2% C and is specially heat treated after casting. Analysis of the Ni alloy steel is given as follows: 0.30% C, 3.25% Ni, 0.20% Si, 0.73% Cr, 0.54% Mn, 0.46% Mo. Maximum stress = 73.6 tons/in.^{2}, yield-point = 69 tons/in.^{2}, elongation in 2″ = 17%, reduction of area = 49.7%, Izod impact = 52 ft.-lb. Kz (9)

Surface Condensers. (Considérations sur les Conditions par Surface.) P. Quinio. *Arts-et-Métiers,* Vol. 85, Aug. 1932, pages 291-299. Corrosion or erosion of condenser tubes are due to the following phenomena. (a) Electrolytic phenomena: These comprise local corrosion caused by galvanic cells when sea water and condensed water which contain salts in solution are in contact with the metal of the tubes or when there are differences of composition between various parts of the same alloy of which the tubes are made. (b) Hydrodynamic phenomena: Cooling water when travelling into the tubes can produce some erosion due to contact friction. (c) Mechanical phenomena. These can be divided into (1) season cracking which appears in brass tubes insufficiently annealed; (2) vibrations; (3) defects from rolling or drawing operation of metals used; (4) defects of packings; (5) erosion due to steam; (6) defects of construction. Remedies to the above defects can be classified as follows (a) Proper selection of alloys: Examples of compositions are given (1) Cu = 70, Zn = 29, Sn = 1; (2) Cu = 76, Zn = 22, Al = 2; (3) Stone metal (chromium plated brass) (4) Cu-Ni containing Cu = 70, Ni = 30 would give the best results and the use of the alloy Cu = 30, Ni = 70 considered. (b) Use of protective coatings. (c) Proper selection of packing: fiber or metal packings. (d) Vibrations are reduced by using a greater number of intermediate plates supporting the tubes. (e) Electrolytic phenomena are cured by using Zn electrodes which must be often cleaned or by using the Cumberland system in which anodes are cast iron plates connected to a small dynamo. (f) For minimizing the hydrodynamic phenomena, the water circulation must be adapted to the need by thorough control of the pumping operation. FR (9)

Pulp and Paper Industry Assumes Leadership in Use of Alloys. *Chemical & Metallurgical Engineering,* Vol. 40, Feb. 1933, pages 80-81. The Technical Association of the Pulp and Paper Industry discussed a specification for a Cr-Ni alloy casting for use for sulphite pulp processing, such as relief valves, strainers, pumps, and digester fittings. The chemical composition includes: Cr—20% min., Ni—9, C—less than 1/100 Cr content, S and P 0.05 max., Si, Mn—left to producer, Fe—rest; Mo—may be specified from 2-4% at option of purchaser. An investigation of recent failures of such a casting showed low alloy content, and deficient Cr in relation to C. A method of lining plain C steel with stainless steel must depend upon welding. PRK (9)

Cast Iron Lighthouse Marks Cape Henry. *Foundry,* Vol. 60, June 1932, pages 31, 56. Following a brief historical discussion, gives some information on the constructional features. VSP (9)

HEAT TREATMENT (10)

New Method of Heat Treating Cast Steel Wheels of Locomotives. (Neues Verfahren der Wärmebehandlung von Stahlgussrädern für Lokomotiven.) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Aug. 20, 1933, page 346.
Brief outline of an efficient method of heat treating cast steel wheels of straight C 1
steel. The time of removing the heated wheels from the furnace and quenching them in the hardening bath amounts to only 40 seconds. Castings treated by the method proved highly uniform, easily machineable and had excellent impact properties. GN (10)

Heat Treatment of Cobalt High Speed Steel. Recommended Practice Committee, A.S.S.T. *Metal Progress,* Vol. 23, Apr. 1933, pages 29,62. The tentative recommended practice for Co steels is given. Approximate composition of 4 types is given in a table. The suggested use is for machining hard rather than soft materials. Forging at 2100°F. with 1650°F. lower limit, and pack annealing at 1600° to 1700°F. with slow cooling is recommended. For hardening, Co steels
should be preheated at 1450° to 1500°F., then transferred to high heat furnace. 2
Double preheat for large tools is desirable. High heat varies according to type, 2325° to 2375°F. for No. 1, 2375° to 2425°F. for types 2-4. Soaking at high heat will cause excessive decarburization and some grain growth. Quenching either in air, air blast, or oil, depends on size and design. Cooling should be done to below 300° and above 100°F. Tempering at 1050°F. with a 2nd tempering at 600° to 650°F. toughens these steels. Correct grinding before hardening is recommended because of the tendency to decarburize in hardening. WLC (10)

Heat Treatment of Chrome Magnet Steels. *Iron & Coal Trades Review,* Vol. 125, Sept. 9, 1932, page 375. Tests on an open-hearth steel with 1.33% C, 0.37% Si, 0.55% Mn, 0.048% P, 0.033% S, 2.15% Cr and 0.065% Ni showed that the coercive force was a maximum with a hardening temperature
from 825° to 900°C. the best aging property was obtained at 850°C. Hardening at 3
higher temperatures than 900° improved the magnetic qualities but made the steel too sensitive with regard to annealing time. Steel damaged by improper heat treatment can be restored by holding at about 1000°C. for an hour or so, then cooling in air. Ha (10)

Rim Toughening Treatment Improves Performance of Car Wheels. *Steel,* Vol. 91, Aug. 8, 1932, pages 23-24. Special process for treating car wheels developed by Carnegie Steel Co. consists in heating wheels to refine grain structure, rotating wheels while quenching rims in water, and then tempering. Rim toughened wheels show decided superiority to untreated in hardness and length of service. Over 50,000 treated wheels are now in use. JN (10)

Liquid Baths For Heat Treating—Bath Furnaces and Temperature Measurements. 4
Paul Eddy, Jr. *Iron Age,* Vol. 131, Feb. 9, 1933, pages 230-232. Oil-fired pot furnaces are satisfactory in very large sizes, though not so desirable as other types in small units because of the long flames. A good resistance furnace with metallic heating elements surrounding the pot is excellent for low and medium temperatures provided bath material is kept away from resistors. Direct-resistance type has been used with some success. Most desirable type is the coreless induction furnace. Gives some important points of design and operation, which apply more or less to all types of both furnaces. Hg thermometers are generally used in oil tempering baths because they are cheap, sufficiently accurate and durable. Thermocouple protection is of great importance. Automatic control may easily be applied to most bath furnaces. VSP (10)

Liquid Baths For Heat Treating—Advantages and Disadvantages of Salt Baths. 5
W. Paul Eddy, Jr. *Iron Age,* Vol. 130, Sept 29. 1932, page 499, adv. sec. page 14. Third of a series of articles. Ideal salt bath imparts neither a hard nor a soft surface to steel, it is inert to metals heated therein. Compares salt baths with oven furnaces and lead baths. States that ideal salt bath has not yet been discovered. VSP (10)

Annealing (10b)

Normalizing Tin Plate. EDWARD S. LAWRENCE. *Blast Furnace & Steel Plant,* Vol. 20, Oct. 1932, pages 763-765; *Heat Treating & Forging,* Vol. 18, Nov. 1932, pages 635-637. Two methods are used for normalizing tin-plate. First involves conventional 2-high mill and the substitution of a continuous normalizing treatment for the first anneal. This is followed by pickling, cold-rolling in 2-high mill, and either pickling and coating or box annealing at a low temperature, pickling, and coating. The other method employs 4-high mills for hot and cold rolling and eliminates the normalizing treatment. Extreme reduction in 4-high cold mill so strains the grain that a subsequent low temperature anneal causes critical grain growth and rearrangement of crystalline structure resulting in the apparently normalized state. To compete with this method, many tin-plate companies have installed normalizers to effect the same result. Should the capacity of these furnaces become too great for the demand of normalized tin-plate, it is probable manufacturers will resort to open or black annealing instead of box annealing to keep such furnaces in operation. MS (10b)

Factors Influencing the Annealing of Cold Rolled Strip Steel. G. R. BROPHY & L. L. WYMAN. *Transactions American Society for Steel Treating,* Vol. 21, June 1933, pages 532-556. Paper presented at Buffalo Convention, Oct. 1932. Influence of normality and degree of cold reduction on spheroidization of carbides in high C cold-rolled strip steel is reported. With increasing amount of cold work steel became softer after annealing at any temperature up to lower critical. Above this temperature hardness increased with more uniformity for all reductions. Up to lower critical, normal steels yielded lower hardness than abnormal steels. At critical temperature for each (745° C. for abnormal and 730° C. for normal on heating), abnormal steel gave best results. In normal steel minimum hardness, and temperature which gives this minimum are dependent on amount of cold work, being lower for high reductions. In abnormal steel, lower and more consistent hardness is obtained for all degrees of cold work at a constant temperature which is higher than for normal steel. 66 micrographs show structure for various reductions in both steels at progressive temperatures. In normal steel, as temperature increases, regranulation and spheroidization affect successively lower reductions and at 800° C. the structure is definitely fine pearlite. In abnormal steel fine pearlite appears at low reductions and gives way to massive carbides at higher reductions. Annealing above critical increases the hardness of both steels. Hardening from 775° C. gives better results in abnormal than in normal steel. Includes discussion. WLC (10b)

Case Hardening & Nitrogen Hardening (10c)

Contributions to the Knowledge of Chill Castings. (Beiträge zur Kenntnis des Schalenhartgusses.) FRANZ POHL & EMIL SCHUEZ. *Mitteilungen aus den Forschungsanstalten des GHH-Konzerns,* Vol. 2, May 1933, pages 145-172. Systematic investigations of the influence of the chemical composition of high C hard iron castings cast in an ingot mold had the following results: Surface hardness increases with increasing C and P content while Si and Mn are of no practical importance for an increase of hardness; an increase of 0.1% C or P respectively increases the surface hardness by 11 or 5.7 Brinell units. By extrapolating the straight line representing the relation of surface hardness to C content a theoretical ferrite hardness of about 55 Brinell is obtained. These figures permit calculating approximately the hardness of any hard cast iron from the C content. The depth of the hardness (quenching depth) is reduced by increasing C, Si and P content while Mn reduces this depth up to 0.4% and then causes an increase. An increase of 0.1% C and P cause a decrease of the depth of 5 and 2 mm. respectively. The graphite content of the mixture of metal and fluxes is important for the metastable solidification which is inhibited by an increase in the graphite content; increasing overheating and lengthening of duration of melting facilitate metastable solidification. Martensitic hard cast iron is formed at 4.3% Ni, 1.3% Cr and 3.65% C under the usual cooling conditions. The influence of thermal conditions is shown by an increase of surface hardness with increasing rate of cooling which influences number of nuclei and crystallization velocity and causes a finer structure. The pouring temperature determines cooling and solidification velocity; cooling velocity increases, solidification decreases with increasing pouring temperature. The quenching depth increases with increasing rate of cooling. Formulas developed by Schwarz for the cooling conditions of liquid metal show a good agreement between calculation and test. 48 references. Ha (10c)

Nitriding Steels; Determining the Effect of Nickel. H. J. FRENCH & V. O. HOMERBERG. *Iron & Coal Trades Review,* Vol. 125, Nov. 4, 1932, pages 692-693. See "The Role of Nickel in Nitriding Steels," *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 321. Ha (10c)

Present Practice in Nitriding Steel. H. A. PEARSON. *Machinery,* Vol. 38, July 1932, pages 809-810. Nitriding is a surface hardening of alloy steel at low temperatures by action of ammonia gas or other gaseous compounds, decomposition of which results in uncombined nitrogen. Nitralloy designates a group of steels of special analyses suitable for use in the nitriding process. Alloy steels containing Al, Cr and Mo, with varying amounts of C are suitable for nitriding. Generally Al content is 1.25%; Cr 1.50%; Mo 0.20%. Grade G nitralloy 0.36% C. Grade H 0.23% C. Nitralloy machines about the same as S.A.E. 1020 steel. Grade H heat treated has a Brinell hardness of 250. Discusses forging, rolling, and tinning. Nitriding is done in an air tight chamber at about 1000° F. Discusses suitable furnaces and method of carrying out nitriding process. After nitriding Brinell hardness of 1000 is common. RHP (10c)

Witherite. As a Chemical Raw Material. H. C. MEYER. *Chemical Markets,* Vol. 32, Apr. 1933, pages 317-319. 12 references. A résumé of properties and uses. The most important use is case-hardening. RAW (10c)

Nitriding of Iron and Iron Alloys. III. (Ueber die Nitrierung von Eisen und Eisenlegierungen.) OSKAR MEYER, WALTER EILENDER & WOLF SCHMIDT. *Archiv für Eisenhüttenwesen,* Vol. 6, Dec. 1932, pages 241-245. The usual temperature at which the nitriding process is carried out is around 500° C., and the operation takes 2 days or upwards to complete, according to the thickness of the case required. The authors' object was to find some means whereby this period could be shortened. By raising the temperature to 600° C. the rate of diffusion of N can be considerably increased, but the hardness of the surface begins to fall rapidly after passing 600° C. and the risk of producing cracks at the higher temperature is much increased. The work of E. G. Herbert on the effect of rotating a steel specimen in a magnetic field led to the idea of trying what the result would be of subjecting annealing and nitriding operations to the influence of high-frequency magnetic fields. It was found that by no means all steels could be uniformly and regularly influenced by nitriding in a high-frequence magnetic field; local differences in the degree of hardness were observed. The best results were obtained with a nickel steel. But in general the diffusion of N was accelerated by the heating of a material in the field of a high-frequency alternating current. (10c)

Nitriding of Nitralloy. MICHITOMO ISHIZAWA. *Suiyokwai-shi,* Vol. 7, Nov. 25, 1932, pages 165-170. Nitralloy containing C 0.42%, Al 1.38%, Cr 1.47%, and Mo 0.25%, previously quenched at 875° C. and tempered at 700° C., was nitrided in a stream of ammonia at 450°-700° C. Nitrided layer was studied by measurement of hardness, microscope and X-ray. Nitrided layer suitable for industrial use does not contain brittle ϵ phase and it must consist chiefly of α and γ phase. The effective temperature in obtaining this layer is 550° C. maximum. HN (10c)

Case-hardening of Iron and Steel. SOKICHI KAWAGUCHI. *Suiyokwai-shi,* Vol. 7, Nov. 25, 1932, pages 156-164. Forged electrolytic iron and low C steel were carburized at 950°, 1000°, and 1100° C. for 3.5 and 7 hr. in mixture of charcoal and 40% soda ash or charcoal and 10% of potassium ferrocyanide. Soda ash mixture was superior to that of potassium ferrocyanide to obtain deep carburized layer. As to temperature no great difference was recognized between 950° and 1000° C., but at 1100° C. cementation was accelerated and a thick carburized case of coarse grain rich in cementite was produced. In various heat treatments of these case-hardened steels, quenching at 950° C. and then at 850° C. was best to obtain martensitic case and fine grained core with neither cementite nor troostite. HN (10c)

New Cementation Process "Durapid." (Un nouveau procede de cementation: le "Durapid.") *Aciers Speciaux, Métaux et Alliages,* Vol. 8, June 1933, pages 192-196. In this new process the material to be carburized is coated with a special semi-liquid paste which contains all the necessary elements for hardening together with different catalyzers in order to accelerate the penetration of C. The material thus coated is heated at 880°-950° C. and then quenched in a special bath which has the physical characteristics of mineral oil. A heating for 1 hr. at the above temperature produces a C penetration of 1 mm. Paste and bath are described only in vague terms. GTM (10c)

Cyanide Carehardening. *Mechanical World & Engineering Record,* Vol. 92, Aug. 5, 1932, pages 128-130. Parts to be hardened are placed in a basket and immersed in molten cyanide. The liquid surrounds each part and insures uniform heating and freedom from distortion. When removed a film of cyanide remains and prevents oxidation during transference to the quenching bath. The fume from the process is slight and not poisonous. Steel suitable for casehardening is of the following composition: 0.12-0.20% C, 0.05-0.10% S, 0.05% and less P, 0.50-1.25% Mn, 0.50-0.80% Si. Depth of the case depends on the duration and temperature during the process. Best results are obtained at 950° C. Parts should be above 760° C. when quenched in water. Kz (10c)

Aging (10f)

Studies on Precipitation-Hardening. Anomalies in Hardening During Hardening Process. (Studien über Ausscheidungs-Härtung. Anomalien im Härteverlauf während des Härtungsvorganges.) G. MASING & L. KOCH. *Zeitschrift für Metallkunde,* Vol. 25, June 1933, pages 137-139, 160-163. The anomalous initial decrease in hardness on high-temperature aging of duralumin, following preliminary aging at room temperature, first noted by Fraenkel and Marx (*Zeitschrift für Metallkunde,* Vol. 21, 1929, pages 2-6) has been studied by M. and K. on Cu-Be alloys with 2.39 and 2.52% Be, respectively, and on a Cu-Be-Mg alloy with 1.01% Be and 1.58% Mg. These alloys are known to harden by simple precipitation. The anomaly was not found for the 2.39% Be alloy, but was clearly evident in the 2.52% Be alloy. Brinell hardness curves are given for the aging of the latter alloy, the aging first partially completed at low temperatures, 150°-200°C., and then continued at higher temperatures, 200°-300°C. In each case an initial softening, followed by a normal hardening was observed at the high temperature. This effect is found whatever the temperatures chosen, requiring only a higher temperature in the second aging treatment. The electrical conductivity drops in the range 150°-200°C. and rises in the range 200°-300°C., suggesting that some distinction might be made between two types of aging, but the initial hardness decrease depends only on a temperature increase which argues against this. The Cu-Be-Mg alloy did not show the effect. The effect is explained on the basis of Volmer and Weber's (*Zeitschrift für physikalische Chemie,* Vol. 119, 1926, pages 277-301) postulation of a minimum size for crystallization nuclei, decreasing with decreasing temperature. In the present case it is assumed that the very small nuclei found at low temperatures dissolve on rapid heating and thus soften the alloy before the larger nuclei characteristic of the high temperature have been formed in sufficient quantity to exert an appreciable hardening effect. The anomalous increase in electrical conductivity at room temperature is explained by a distortion of lattice caused by the nuclei; this effect is great when the number of nuclei is great. Data are given in the variation of electrical conductivity of duralumin (0.22% Si, 4.40% Cu, 0.09% Zn, 0.40% Fe, 0.35% Mn, 0.66% Mg, the rest Al) with treatment similar to that described above. It is found that the initial hardness decrease at the higher aging temperature is accompanied by an increase in electrical conductivity, thus lending support to the theory that the anomalous electrical conductivity decrease is associated with distortion effects from many small nuclei. Aging treatment consisting of partial aging at a high temperature followed by aging at a low temperature shows the usual decrease of conductivity at the low temperature. The observation of Fraenkal and Marx, that alloys which show no change in electrical conductivity on aging at room temperature will exhibit the usual decrease if the alloy is first partially aged at a high temperature, is explained by a concomitant precipitation of both large (in high concentration areas) and small (in low concentration areas) nuclei in an alloy with inhomogeneous distribution of solute, the two precipitation effects cancelling each other, whereas an initial high temperature aging precipitates the solute in the areas of high concentration, allowing the normal low temperature aging effects to manifest themselves later. RFM (10f)

Aging and Age Hardening in Metals. C. H. DESCH. *Metal Industry,* London, Vol. 42, Jan. 6, 1933, pages 3-5, 10. Mechanism of hardening of metals and structural or chemical changes taking place are discussed. It is generally accepted that hardening is due to precipitation of a constituent from solid solution; on quenching the alloy a certain substance was held in solid solution and in the first stages formed very minute particles which formed an obstacle to slip and increased the hardness. This particular substance was found to be, in duralumin, $CuAl_2$, and also Mg_2Si so that a double hardening was possible. Other systems of elements capable of showing age hardening are given in the following where the solubilities before and after hardening are also given: Cu in Ag, 8.8% falling to 2%; Ag in Cu, 8.2% falling to 2%; Fe in Mo, 11.0% falling to 5%; Mo in Fe, 24.0% falling to 6%; C in αFe, 0.04% falling to 0.008%; N in αFe, 0.4% falling to 0.015%; Ti in Cu, 4.0% falling to 0.4%. Different heat treatments to bring about hardness are described briefly and methods of determining nature of changes by determining electrical conductivity or X-ray patterns explained. Nature of N hardening is discussed, and blue-brittleness defined as an aging effect, that is the precipitation of molecules first of all, and then the joining up of these to form nuclei. In case of mild steel aging could be avoided by keeping N down. Some austenitic steels can be age hardened. Ha (10f)

Studies on Hardening Phenomena in Britannia Metal. (Untersuchungen über Aushärtungserscheinungen bei Britanniametall.) M. v. SCHWARZ & O. SUMMA. *Zeitschrift für Metallkunde,* Vol. 25, Apr. 1933, pages 95-97; correction, May 1933, page 123. The crystal structure of alloys of Sn and Sb with 10%, 20%, 30%, 40%, 50%, and 80% Sb was studied by X-ray diffraction. 10% Sb increases the spacing of the Sn lines slightly; 20% Sb produces a eutectic mixture; 30% and 40% Sb shows a superimposition of Sn and SnSb lines—no lines for a compound Sn_3Sb_2 were found; 50% Sn shows only the lines of the compound SnSb, which is body-centered cubic, a_0 = 6.13 A.U.; 80% Sb shows lines for SnSb solid solutions. The constitution of a cold-worked 8% Sb alloy was studied in a similar way: (1) cold-rolled 24%, without heat-treatment and annealed at 175° for 90 minutes, air cooled, only Sn lines were formed; (2) cold-rolled 51%, without heat-treatment only Sn lines were formed, but with the previous heat-treatment the strongest lines of the compound SnSb were formed; (3) cold-rolled 78%, without heat-treatment only Sn lines were formed, but with the previous heat-treatment many lines of the compound SnSb were formed. The increase in hardness observed in Britannia metal following the heat-treatment after cold-rolling, is thus to be explained by the precipitation of the compound SnSb. RFM (10f)

JOINING OF METALS & ALLOYS (11)

Joining of Light Metals (Leichtmetall-Verbindungsarbeiten) *Aluminium,* Vol. 15, June 15, 1933, pages 2-5. The various methods of joining light metals, i.e., folding, fluting, bolting, soldering, welding and riveting are discussed. Folding is applied only for soft materials and where no appreciable stresses occur; bolts should be of the same material as that to be united. Soldering is done with hard-solder, rich in Al, or with soft solders, rich in heavy metals. Hammer-welding, gas fusion-welding, electric fusion and resistance welding are widely used, especially for pure Al and unrefined Al alloys; for refined alloys it is admissible only when the reduction in strength due to the heating is of no consequence. Testing of joints and preparation of work are briefly treated. Ha (11)

Girders and Columns in Structural Steel Work (Balken en kolommen in den staalskeletbouw) E. A. van Gendere Stort. *Polytechnisch Weekblad,* Vol. 26, Feb. 7, 1933, pages 97-101. Joining by riveting and welding with reference to girders and columns is illustrated and discussed. WH (11)

Welding of Aluminum (A Propos de la Soudure de l'Aluminum) R. M. *Revue de la Soudure Autogene,* Vol. 24, July 1932, page 2558. Distinction is made between soft soldering, which is almost impossible to perform with tin solder and fusion welding which is quite a commercial method of joining aluminum. It is explained that failures with soldered pieces are due to electrolytic actions which occur in cells resulting from the contact of Al and the soft solder alloy. In fusion welding a reducing flame must be used and it is preferable to substitute air for oxygen in the torch. FR (11)

Brazing and Welding Technique. D. J. Thomas. *Mechanical World & Engineering Record,* Vol. 92, Sept. 23, 1932, pages 285-287. The 3 methods of brazing in general use are classed as (1) blowpipe brazing, (2) dip brazing, (3) hydrogen welding or soldering, involving pure Cu as jointing material and being exercised in a furnace containing free hydrogen. Alloys for the brazing of iron and steel contain 50-55% Cu and 45-50% Zn. (1) and (2) necessitate temperatures over 950° C. which lowers the properties of iron and steel. In case of failures fractures take place usually 1 in. from the actual joint. Discussing fluxes the composition of one is given as: Na_2CO_3, 22.63%; CaF_2, 22.81%; SiO_2, 26.68%; Fe_2O_3, 9.42%; HgO, 3.19% and H_2O, 15.10%. Special attention is paid to blowpipe welding of Cu and Cu alloys, the strong affinity of which for H_2, O_2, and CO necessitates the use of deoxidizers, which are discussed in connection with various welding rods. Dealing with arc welding of Cu and its alloys the machinery used is touched upon. A general procedure for welding of cast iron is given and (1) the burning on process, (2) electric arc, (3) oxyacetylene (4) thermit method are discussed. Advantages of bronze welding for cast iron repairs are dealt with. Kz (11)

Table of Welding Processes (Tableau Synoptique des Procédés de Soudure) R. Granjon. *Revue de la Soudure Autogene,* Vol. 24, Aug. 1932, pages 2574-2575. Table is explained in the article. FR (11)

Brazing (11a)

Assembly of Steel Stampings by Continuous-Furnace Brazing. C. L. West. *Metal Stampings,* Vol. 6, June 1933, pages 173-176; *Iron Age,* Vol. 132, July 27, 1933, pages 15-16, 66. Electric Furnace Company, Salem, O., has developed a method for joining steel parts such as stampings, forgings, and screw-machine parts by brazing in electric furnaces with controlled reducing gas atmosphere at temperatures ranging from 1400°-2100° F. Brazing materials used are Ag solders for temperatures of 1400°-1600° F.; brass alloys for temperatures of 1740°-2000° F.; and Cu for 2100° F. Joints to be brazed should fit closely together and the parts should be clean. For brazing operations up to 1800° F., an electric furnace with a belt conveyor of heat-resisting alloy is commonly used. For temperatures as high as 2100° F., simple pusher type furnaces are used, the work being conveyed on light shoes or trays of heat resisting alloy. Cooling chamber is attached to the heating chamber. Reducing atmosphere is produced at the brazing furnace location, cost varying from 20 to 30c./1000 ft.^{3}. MS (11a)

Copper Brazing, Strong, Light Joints Made in Furnace. C. L. West. *Metal Progress,* Vol. 24, July 1933, pages 44-48. Continuous brazing in a controlled protective atmosphere furnace is described. Brazing material in wire, powder, or granule form, is placed on the joint to be made. On melting it spreads over the clean deoxidized surface and is pulled into the joints by capillary action. Ag solders are used where light color or corrosion resistance is necessary. Melting range is 1250° to 1600° F. with cost varying from 20 to 75c per troy oz. Brass solders melt from 1450° to 1625°. Brazing temperature is 1740° and nearly 2000° when powder is used. Price of brass alloys varies from 14 to 27c per lb. Pure Cu is necessary for brazing steel parts. Melting point is 1980° with brazing done at 2040°. Cost varies from 10c per lb. for the wire to 16c for the powder. Tight fits in the joints to be brazed are desirable. Gaps are difficult to braze. Parts should be clean as scale or C interferes with brazing. Furnaces are conveyor operated up to 1800°, pusher operated for brazing at 2040°. A double wall cooling chamber, water cooled, with the same atmosphere as the heating chamber is attached. The gas used for the atmosphere is produced in a small gas producer. Cost of the gas is much less than the H_2 formerly used and simplifies the furnace design as air-tightness is not as necessary. Instances of higher strength with lower cost of production are illustrated and described. An advantage of Cu brazing is that subsequent heating operations are below the melting point of Cu. Annealing is simultaneous with brazing in some cases. WLC (11a)

Practical Slants on Electric Furnace Brazing. H. M. Webber. *American Machinist,* Vol. 76, Nov. 23, 1932, pages 1153-1155. Brazing in an electric furnace is done preferably with a controlled atmosphere of H or other reducing gases taking place of flux otherwise employed in brazing. Good clean brazed parts are obtained. Examples of brazed pieces are shown. Ha (11a)

Brazing Metals with Silver Solders. A. Eyles. *Machinery,* Vol. 38, Feb. 1932, pages 430-431. See *Metals & Alloys,* Vol. 3, May 1932, page MA 134. RHP (11a)

Theory, Technique and Application of Brazing (Théorie, Technique et Application de la Soudo-Brasure) H. Gerbeaux. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 3, Mar.-Apr. 1932, pages 563-582. Lecture before the "Société des Ingénieurs Soudeurs." Principles of the process are described at length. FR (11a)

Brazing (Le multiple intérêt de la soudo-brasure) *Le Soudeur Coupeur,* Vol. 12, May 1933, pages 3-6. Various applications of brazing for repair of machine parts. RRS (11a)

Fabricating Products by Electric Furnace Brazing H. M. W. *Machinery,* London, Vol. 42, July 20, 1933, pages 461-464. Discussion of the method of brazing. Multiple-joint parts, made of steel, are well adapted to electric furnace brazing, because the seams can all be joined in one passage. Cu can be applied in the form of wire, chips, or paste. When the molten Cu flows into the joints, a small amount of Fe goes into solution with it, forming an alloy bond stronger than Cu itself. Tests show an increase of 50% in strength. Discussing the advantages of electric furnace brazed constructions various examples are dealt with. Photomicrograph shows tendency towards grain growth across joint and the penetration of Cu into the steel along the grain boundaries. Kz (11a)

Fluxes for Brazing. D. J. Thomas. *Mechanical World & Engineering Record,* Vol. 92, Nov. 4, 1932, page 430. Successful brazing of any metal depends on the preparation and application of a suitable flux. Means of preventing oxide formation physically and chemically are discussed. A flux is essential to prevent local oxidation, and a reducing agent can be mixed with the flux and brazing solder to decompose any oxide which may be formed. Formulae for different classes of work are given. Kz (11a)

Welding and Cutting (11c)

Welded Street Cars and Motor Vehicles (Geschweisste Strassenbahnwagen und Kraftwagen) O. Bondy. *Verkehrstechnik,* Vol. 50, May 20, 1933, pages 249-250. Advance of welding methods in vehicle construction. Practical experiences gained in other fields of welding technique such as sheet joining, building and bridge construction, ship building. Fundamentally new designs of welded vehicles as compared with those assembled by riveting and bolting. WH (11c)

Welded Railroad Constructions in Berlin (Geschweisste Bahnhofsbauten in Berlin) Otto Bondy. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, June 4, 1933, page 315. Illustrated description of construction and welding of recently built railroad platforms at various Berlin stations of the German State Railways. GN (11c)

Cutting Steel with Oxygen Machines. C. G. Bainbridge. *Metallurgia,* Vol. 7, Feb. 1933, pages 101-102; *Mechanical World & Engineering Record,* Vol. 92, Dec. 2, 1932, pages 528-531. See *Metals & Alloys,* Vol. 4, Aug. 1933, page MA 259. JLG + Kz (11c)

Oxygen Machine Cutting in Great Britain. C. G. Bainbridge. *Transactions American Society of Mechanical Engineers,* Vol. 54, Oct. 15, 1932, *Machine Shop Practice,* pages 119-126. Use of machines for holding oxygen flame cutter rigidly and propelling it by a simple feed motion at uniform speed is described. The work done is much smoother and more accurate than by hand-cutters. Ha (11c)

Points to be Observed in Welding Cast Iron (Was soll beim Schweissen von Gusseisen beachtet werden?) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Aug. 6, 1933, pages 321-322. Repairing Fe castings by filling the defect with liquid metal is considered. Procedure to be followed in various cases is outlined. Heating of parts thus repaired is particularly referred to. GN (11c)

Fusion Welding of Floating Roofs. *Welder,* Vol. 4, June 1933, pages 23-26. All-welded floating roofs for large oil tanks are considered to be superior in case of fire. Examples of how the work is done and care taken of the expansion are briefly described. Ha (11c)

Oxy-Acetylene Welding of Brass and Bronze. *Welding News,* Vol. 3, July-Sept. 1932, pages 45-47. It is shown how through use of an oxidizing blowpipe flame which can be easily adjusted to characteristics of material to be welded, oxy-acetylene fusion welds of high quality and soundness can be made especially in commercial brasses and bronzes for ornamental work. Ha (11c)

A Successful Electric Welding Repair to Ship's Stern Post. *Welder,* Vol. 4, Dec. 1932, pages 30-32. Detailed description of repair of a fracture across frame just underneath propeller of a cargo steamer. Ha (11c)

Arc Welding for the Construction of Ships. III. *Welder,* Vol. 4, June 1933, pages 8-12. Physical qualities of welds as revealed by tests are described. The reason for residual stresses and their avoidance and elimination by heat-treatment is discussed. Combined use of riveting and welding should be discouraged as a weld in contracting is sure to strain the rivet so that the welding should be completed before the rivets are added. But even when this is done "rivet slip" might occur at even moderately low stresses so that the rivets cease to function and throw their work onto the weld. Ha (11c)

Cast Iron Welding at the Works of T. & J. Stevenson, Kilmarnock. *Welder,* Vol. 4, June 1933, pages 21-22. Welds of small cross section are made with the electric arc using Ni alloy cast iron electrodes of No. 10 S.W.G. Several examples are described. Ha (11c)

Detroit Plant Installs New Copper Hydrogen Furnace. *Steel,* Vol. 91, Oct. 10, 1932, page 27. The copper hydrogen electric welding process and a large semi-continuous pusher-type electric furnace for this type of welding are described. JN (11c)

Fusion Welding of Aluminum (La Soudure Autogène de l'Aluminium) *Soudure et Oxy-Coupage* (Supplement to *Revue de la Soudure Autogene*), Vol. 9, May-July 1932, page 150. Only oxy acetylene welding is used on aluminum. The seam must go through plates and the added metal must exceed the level of the plates on both sides, the surplus being hammered and the seam subsequently annealed and then machined on each side. Added metal must be of high purity and the same applies for the metal of the plates. Examples of welded aluminum tanks used in the brewery industry are given. FR (11c)

Welding of Heavy War Ships (La Soudure des Gros Navires de Guerre) P. Senn. *Revue de la Soudure Autogene,* Vol. 24, Sept. 1932, page 2603. According to the 1932 Washington Conference, the maximum tonnage for cruisers is 10,000 tons. In order to increase efficiency of the units for such a given weight high strength steels, light metals and fusion welding have been used. Construction details of the American warship "New Orleans" are given and indication is made that the process has received much attention in construction of English ("Leander" and "Achilles") and French ("Algerie") similar cruisers. FR (11c)

Welded Auto Bodies (Les Carrosseries Soudées) R. Salelles. *Revue de la Soudure Autogene,* Vol. 24, Sept. 1932, pages 2600-2603. Metal auto bodies are adopted by all leading manufacturers who use fusion welding which leaves no trace after grinding and painting. Spot welding is preferred by motor-car manufacturers in repetition work. This type of welding is not so common as body manufacturers generally use oxy-acetylene welding due to its particular flexibility. Author describes various stages of welding a large bus body. FR (11c)

Extending Life of Rail by Gas Welding. *Railway Engineering & Maintenance,* Welding Number, Feb. 1933, pages 66-67, 84. Illinois Central's experience in reconditioning 845,000 joints indicates economy of practice now standard on this railroad. The torchman places his marks on every joint he builds up by means of a die so that responsibility for workmanship can be traced correctly. Normal rail metal after subjected to the cold rolling action of car and locomotive wheels exhibits a Brinell hardness of 260-265. Scleroscope tests made immediately after grinding and reduced to the Brinell scale have shown hardnesses ranging from 325-350. Tests made about 1 year after the welding was done have shown increases extending up to 400. Except occasional joints, batter has been definitely retarded in all cases and practically eliminated in many of them. WH (11c)

Cropping of Rail Ends is Effective. *Railway Engineering & Maintenance,* May 1933, page 239. Experience on 2 jobs covering 32 track miles indicate that the acetylene torch furnishes an economical means and does not result in damage to the metal. WH (11c)

Building-up Rail Ends with the Electric Arc. *Railway Engineering & Maintenance,* Welding Number, Feb. 1933, pages 74-76, 79. An account of the details of inspection, preparation, equipment, and workmanship that are employed on the New York Central to obtain the maximum benefit. Hardness tests are made with the rebound scleroscope. There are no indications of a tendency toward secondary batter as a result of the greater hardness of the welded metal. The considerably varying degree of hardness depends on the skill of the operator, type of rod, intensity of arc, rate of application and depth of the metal applied. Satisfactory results are obtained by using a 5% Ni rod. WH (11c)

Pennsylvania Arc Welds Crossings by Contract. *Railway Engineering & Maintenance,* Welding Number, Feb. 1933, pages 72-73, 86. Life of some 300 crossings in the Western Region has been appreciably extended as a result of repair work done during the last 3 years. The welding contractor must guarantee the work for 90 days. Defects on Mn steel trackwork are due to batter, crushing, faulty metal and cracks. The parent metal should not be heated above 800° F. to prevent a breaking down of the austenitic structure of Mn steel and welding currents should not exceed 120-125 amps. on Mn work. The welding rod should be limited to 3/10" diameter. WH (11c)

Welded Joints Improve Tunnel Track Conditions. *Railway Engineering & Maintenance,* Welding Number, Feb. 1933, pages 85-86. Work done by Central of Georgia in 1930 stands up well and results in largely reduced maintenance expense usually excessive in tunnels. WH (11c)

Can Angle Bars be Built-up? *Railway Engineering & Maintenance,* Welding Number, Feb. 1933, pages 77-79. New Haven restored more than 200 track miles of joints by welding in 1932, and plans to continue work over a large scale. Chart showing graphically joint conditions at 4 joints before and after built-up angle bars were applied. Bars turned to balance wear conditions. Details of making welds. WH (11c)

Electric Ship Welding (Het electrisch lasschen van schepen) *Polytechnisch Weekblad,* Vol. 26, Dec. 15, 1932, pages 798-800. Attention is focussed on all-welded German ship of 22.5 m. length on which 20% in weight has been saved due to the adoption of welding. Reference is furthermore made to the all-welded American oil tankers "Carolinian" and "Lucy" of 36.60 m. and 45.25 m. length respectively. WH (11c)

Fabricated Structures. *Mechanical World & Engineering Record,* Vol. 92, Nov. 4, 1932, pages 434-435. Many products which are at present built up from castings, and which are riveted, can be cheapened and improved in strength, lightness, and general appearance by the adoption of electric welding. In the article some outstanding examples of welding are reviewed and properties of welds discussed. Kz (11c)

Investigations into the Welding of Pressure Vessels. *Mechanical World & Engineering Record,* Vol. 92, Nov. 11, 1932, pages 459-460. Oval holes milled through a weld form a simple method of examination. The machined surface can be etched to show the "runs" and the hole filled with fresh weld metal. Interleaved joints have been found to encourage the trapping of slag, and therefore are not recommended. Conclusions are given on investigation into the contour of welds. Bare-wire electrodes are not recommended for welding pressure vessels. Kz (11c)

German-built 18,000-ton Tanker. *Marine Engineer & Motorship Builder,* Vol. 56, Feb. 1933, page 55. Feature of construction of hull is extent to which welding has been used. Kz (11c)

Welding Aluminum (La soudure de l'aluminium) *Le Soudeur-Coupeur,* Vol. 12, Apr. 1933, pages 4-12. A series of articles reviewing the development of welding of Al. Lists and gives illustrations of 20 welded Al devices for heating water and generating steam. Describes welded light Al alloy engine shells; and gives a detailed description of a welded Al canoe. RRS (11c)

Boiler Repairs by Welding. *Gas Engineer,* Vol. 57, June 1932, page 305. Valuable time was saved by welding applied to the repair of furnaces of a ship's boiler at Bombay. The new furnace, 4 in. larger in diameter, was found available in India. The damaged furnaces and the new one were cut in halves. The new top halves were reduced to the correct size by means of jigs and the edges were veed for welding. The 2 halves were then securely tack-welded together, taken on board and fitted into place. New saddles forged on the side were also tack-welded into place. The furnaces were then taken back to the shops to complete electric arc welding. After annealing, the furnaces were finally riveted into the boilers and hydraulically tested to 200 lbs./in.^{2}. WH (11c)

Cutting Scrap Steel with Town Gas. *Gas Engineer,* Vol. 57, July 1932, page 413. In the ordinary way acetylene can cut scrap to any desired shape, but the edges of the cut part are usually ragged and deformed as a result of the excessively high temperatures employed. The moderate temperature of coal gas plus compressed O_2 yields a clean and sharply cut surface. The salient features of the cutting machine are described at length. WH (11c)

Electrically Welded Concrete Reinforcement. *Gas Engineer,* Vol. 58, Mar. 1933, pages 143-144. The present method of overlapping, hooking and tying reinforcement bars leaves much to be desired. Reliable joints may be obtained by welding which excludes the danger of slip and guarantees the proper transference of stress. The application of butt and lap welding in this field is discussed. Welded sleeve joints on bars varying in diameter from ⅝" to 1½" were tested and in all cases 100% strength efficiency was obtained. WH (11c)

Laying Welded Mains Across Rivers. *Gas Engineer,* Vol. 57, June 1932, pages 296-297. The single V butt type weld is generally used in river crossing work. In case of severe service conditions welded sleeves or welded transverse reinforcing bars are employed. Standard river clamps placed over the welded joints guard against possible movement. The installation methods depend on the conditions and may include drawing into position by teams or tractors, construction of a bridge, welding of double lengths into position on a barge moving progressively along the line of crossing. Laying mains across ice is discussed in great details with emphasis of safety means, protection of welders, cutting through the ice. Next the unique features marking a 13,000 ft. double pipe line river crossing from the same barge at the same time are discussed. WH (11c)

All Welded Steel Frame Building Erected in London. *Gas Engineer,* Vol. 57, May 1932, pages 241-243. The building covering an area of 37,000 ft.^{2} is not designed as a riveted job with the substitution of welds for rivets but to obtain all the advantages to be gained by welding. The total weight of the steel work is about 132 tons. Full details are given. WH (11c)

Recent Mainlaying in Canada. *Gas Engineer,* Vol. 57, Sept. 1932, pages 499-500. Practical tests on 2 oxy-acetylene welding systems designated as "ox-welding" and "Linde welding" are reported. The latter differing from the former in 3 main particulars: (1) a special flame adjustment, (2) the use of a special welding rod and (3) a new welding technique. The comparative results on these 2 jobs were as follows:

	oxwelded lines	Linde-welded lines
average time/weld-tacking + welding	13-16 min.	8¼-16 min.
average number of welds/day	20	30-40
maximum number of welds/day	25	53

The speed of welding in Lindeweld process is dependent on the speed at which the rod can be melted. Welding is done at the top of the pipe which is rotated away from the welder. WH (11c)

Welded Construction and Maintenance on Gas Works. *Gas Engineer,* Vol. 58, July 1933, pages 357-358. Gives some details on the recent erection of gas holders by electric welding. Further application in gas works refer to mainlaying, assembling of steel hoppers, addition of new metal to scrubber shafts, reinforcement of defective boiler furnaces and to a great number of repair jobs. WH (11c)

Specifications on Delivery of Materials Used in Gas and Arc Welding of Steel (Bedingungen für die Lieferung und Abnahme von Zusatzwerkstoffen für die Gas- und Lichtbogenschweissung von Stahl) *Die Elektroschweissung,* Vol. 4, July 1933, pages 130-134. The specifications given deal with (1) conditions of welding rods (a) surface, (b) tolerances of dimensions, (c) types and mechanical properties, (2) quality tests of welds (a) rod diameter in relation to plate thickness, current, etc. (b) tensile tests of welded samples—tensile test, notched impact test, forgeability test, plasticity of welds, (3) specifications on the purchase of welding rods. GN (11c)

Change of Specifications of Welded Steel Constructions D I N 4100 (Änderung der Vorschriften für geschweisste Stahlbauten D I N 4100) *Die Elektroschweissung,* Vol. 4, July 1933, page 134. The change of the D I N 4100 specifications suggested and submitted for approval to the German State governments and the German Committee on Standardization particularly refer to permissible loads of butt and lap welded seams of steel 00 and 37. GN (11c)

Automatic Carbon Arc Welding. *Electrical Review,* Vol. 112, Feb. 3, 1933, pages 150-151. Brief illustrated description of equipment for automatic welding. Welding speeds up to 120 ft./hr. are available, the most suitable average speed being 70 ft./hr. MS (11c)

Producing Welded Steel Tube. *Electrical Review,* Vol. 112, Apr. 7, 1933, page 491. Describes manufacture of tubes by resistance welding at the Oldbury works of Tube Products, Ltd. MS (11c)

All-welded Test Bridge. *Electrical Review,* Vol. 113, July 14, 1933, page 47. Swiss Federal Railways has erected a full-scale section of a bridge for investigation. Design called for (a) the use of plates and flats for building up all cross girders, rail bearers, and main girder members, thus eliminating rolled-steel sections as far as possible, and (b) the butt welding of all joints. MS (11c)

Welding Reduces Costs in Diesel Power Plants. *Diesel Power,* Vol. 11, Feb. 1933, page 93. Describes a welding job done on a 210 HP 6 cylinder engine. The cylinders were formed in blocks of 3, and the 2 water-jacketed exhaust manifolds were connected together in the center by a gasketed joint. The latter formed a constant source of trouble due to leaking. Bronze-welding the exhaust manifolds together remedied the annoyance. The delicate welding job finished in 6 hrs. is described in full detail. The castings were worth new about $2000 which were saved due to the use of the oxy-acetylene process. WH (11c)

The Hard Weld Junction in Cast Iron. A. T. Roberts. *Welder,* Vol. 4, Feb. 1933, pages 11-15. Welding of unpreheated cast iron results in the production, at and near the weld junction, of a zone of greater hardness because of the great rate of cooling as the dissolved C has no time to reprecipitate completely and a proportion of the graphite combines with the Fe as excess cementite which forms the hard and brittle constituent of white cast iron. By applying an electrode of a Ni-Cu alloy of a melting point of about 1300° C., similar to that of cast iron, the increase in hardness of the joint is only about 33% while when using a mild steel electrode an increase of up to 100% in hardness may occur. Also, the microstructure of the normal cast iron continues almost to the weld junction and no C combines with the Ni-Cu alloy deposit. Ha (11c)

The "Disturbed Area" in Mild Steel. A. T. Roberts. *Welder,* Vol. 4, Apr. 1933, pages 14-19; June 1933, pages 1-2. By "disturbed area" is meant that volume of metal adjacent to a weld deposit which has undergone a change in its physical properties as a result of welding. The structure of a mild steel with pearlite, ferrite, austenite is explained and the changes in the welding zone due to heat and stresses developed there discussed. The physical properties of the annealed (disturbed) zone in relation to those of the original steel depend also on the degree of cold work in the steel prior to welding; in severely cold-worked steel the welding heat will relieve strains set up in the cold work while near the weld, properties might be found similar to those obtained by cooling in an airblast. In case of annealed steels, effects of welding are not so marked. Ha (11c)

Flame Cutting Cast Iron (Das Brennschneiden von Gusseisen) E. Zorn. *Werkstattstechnik,* Jan. 1, 1933, pages 11-13; Jan. 15, 1933, pages 31-33. Many practical hints as to preheating, auxiliary means and materials, proper construction of the torch, questions of combustion, of the right way of proceeding with the torch, continuance of a suspended cut, etc. The rate of speed in relation to thickness is illustrated by curves. The limits of application are shown by the slow speed and the uneven surface of the cut. The aim must be to burn the iron and not to melt it. Tapping of a blast furnace is mentioned as an example. RV (11c)

Present Use of Welding in the Pressure Vessel Field. William Spraragen. *Iron Age,* Vol. 129, Jan. 14, 1932, pages 161-165 (To be concluded). Advance in use of welding in pressure vessel field has been made possible through the more liberalized rules and regulations by boiler code committee of A. S. M. E. Present rules and regulations have been brought about by several factors, most important of which are: (1) Growing confidence in welding; (2) Development of new materials and technique of welding which result in tensile strengths and ductilities not heretofore possible; (3) Greater regularity in quality of welds; (4) Development of non-destructive methods of testing; and (5) Economic need for welding as means of fabricating vessels and drums of greater thickness. VSP (11c)

Arc Welding with Alternating Current. G. W. Stubbings. *Mechanical World & Engineering Record,* Vol. 91, Apr. 1, 1932, page 318. The prevailing use of the d.c. for welding has been due to the following disadvantages of the a.c.: The necessity of an undesirably high voltage on open circuit in order to start the arc, and the difficulty in controlling the arc, particularly when using the small currents required for thin material. A new type of a.c. arc-welding outfit has recently been developed, consisting of a transformer provided with means of adjusting the current by small stages, together with a subsidiary oscillating circuit, the object of which is to stabilize the arc. In point of lightness, portability, and cheapness the a.c. equipment is better than the d.c. plant. Kz (11c)

Electric Butt Welding of Large Cross Sections of Chromium Steel (Elektrische Stumpfschweissung von Chromstählen grosser Querschnitte) E. Schmatz. *Werkstattstechnik,* Vol. 27, Jan. 15, 1933, pages 35-36. Based particularly on the low electric conductivity diminishing with the increasing Cr content, a butt welding machine was designed which welds steel up to 6% Cr and 25000 mm.^{2} cross section. Very high pressure has to be employed for pressing the 2 parts together. Particulars of the machinery and of the electrical equipment are described. RV (11c)

Correct Measurement and Marking of Welded Seams (Richtiges Messen und Anreissen von Schweissnähten) H. Schmuckler. *Die Schmelzschweissung,* Vol. 11, Nov. 1932, pages 243-245; *Elektroschweissung,* Vol. 3, Nov. 1932, pages 211-212. See *Metals & Alloys,* Vol. 4, July 1933, page MA 236. Ha + GN (11c)

Foundations. Wm. Scholz. *Marine Engineering & Shipping Age,* Vol. 38, May 1933, pages 178-181. The article discusses the structural design and the distribution of the stresses in built up foundations for marine oil engines in which loosening of the riveted connections has been experienced. By the construction of completely welded foundations, in which the holding-down bolts are arranged in the plane of the girders arranged to take up the stresses, a method is indicated which overcomes this defect in the foundations. Kz (11c)

New Apparatus for Cutting in Water (Ein neues Unterwasser-Schneidgerät) Br. Schulz. *Schiffbau, Schiffahrt und Hafenbau,* Vol. 34, July 15, 1933, page 261. The torch burns a mixture of "Blaugas" (highly compressed oil gas), benzine and oxygen. The pressure can be proportioned to the water depth. The tip whose direction may be changed with respect to the torch axis, is firmly placed against the work. The flame temperature is about 3500° C. due to the liberation of 43.454 thermal units/hr. as compared with 15.625 thermal units/hr. for the hydrogen torch. The explosion danger is reduced from 57% for the latter to 3.9% for the former with respect to the critical gas composition. The cutting speed has been stepped up 5 times. The greater economy is indicated since the total weight per equal calorific power has been cut down from 7340 kg. to 200 kg. WH (11c)

Measuring Weld Seams (Messen von Schweissnähten) F. Schmuckler. *Werkstattstechnik,* Vol. 27, Jan. 15, 1933, pages 37-38. A new patented instrument for the gaging of all types of welds is described and its manifold possibilities of application explained. RV (11c)

Electric Arc Welding in Connection with Gasworks Plant. H. H. Hollis. *Gas World,* Vol. 97, Dec. 17, 1932, pages 586-587. **Rivet or Weld?** H. H. Hollis. *Gas Journal,* Vol. 200, Nov. 30, 1932, pages 628-630; *Gas Engineer,* Vol. 58, Jan. 1933, pages 27-29. Both articles are extracts of the original paper presented before the Yorkshire Junior Gas Association Nov. 19, 1932. Include discussions. Author compares essentials of a good riveted joint (8 in number) and those of a good welded joint (also 8 in number). It is impossible to construct a riveted joint to give 100% efficiency. It is, however, possible to construct a welded joint to give this efficiency. The tests for weld defects are given and the advantages of welded joints over riveted joints. The latter include: less cost, greater strength and rigidity, silent construction, no leaking seams, improved appearance, and easy repair. The author makes a plea for a change in the law which definitely prohibits welding on steel structures more than one story high, which is now in force in England. WH + MAB (11c)

Manganese Trackwork Can be Repaired by Welding. *Railway Engineering & Maintenance,* Welding Number, Feb. 1933, pages 68-71, 84. Experience of the Lehigh Valley which has built up 350 turn out and 60 crossing frogs, demonstrates practicability of arc-welding in the field. The earlier difficulties of cracking, chipping off or actually coming out are overcome. The former straight Mn steel welding rod containing the approximate Mn content of the work to be repaired (12-15% Mn) has been abandoned in favor of Ni-Mn rods containing 0.6-0.8% C, 13-14% Mn and 3-5% Ni. Success depends on proper cleaning of the cavity, proper application and anchoring of the new metal (mild steel inserts) and proper grinding or polishing of the new metal to the correct level. The rod steel is deposited in a series of beads from ⅝" to ¾" wide and 5/32" to 7/32" high followed by peening with a 1 pound hammer. A 3/16" rod has been found best adapted. Worn crossings costing from $1400 to $1600 each can be restored to their original state of serviceability with an average expenditure of about $50. WH (11c)

Oxy-acetylene Welding of Metals and Alloys (La Soudo-Brasure Oxy-Acétylénique des Métaux et Alliages) *Revue de la Soudure Autogene,* Vol. 24, Sept. 1932, pages 2594-2596. Added metal cannot be ordinary brass because under torch flame, Zn would volatilize rapidly. To prevent escape of Zn an oxidizing flame is used; Zn at the surface oxidizes thus forming a protective layer which impedes Zn volatilization. It is however necessary to add certain elements such as Si to obtain correct welds without defects. Welding applied to joining cast Fe parts is described. The added metal does not enter a tight joint, therefore when a deep penetration is aimed at, the edges of the two parts must be beveled. It is not possible to repair a casting in the as broken condition because the fracture is along graphite flakes and graphite is known to prevent wetting of the added metal, thus parts should be machined in the joint in order to cut transversely the graphite flakes. Sand blasting is recommended for cleaning the machined surfaces and removing graphite present. Joints as resistant as the cast Fe itself can be obtained. FR (11c)

Experiences with Fusion Filler Metal on Manganese-hard Steel (Erfahrungen bei autogenen Auftragsschweissungen auf Manganhartstahl) Ernst Greger. *Der Autogen Schweisser,* Vol. 6, June 1933, pages 76-77. After discussion of technical instructions to be observed in welding of Mn-steels containing up to 14% Mn, precautions to be taken in repairing machine parts, made from Mn-steels by fusion-welding are dealt with. The application of a special Mn welding rod is advised but no composition is given. Kz (11c)

Welding of Non-Ferrous Metals (Das Schweissen von Nichteisenmetallen) Ernst Greger. *Zeitschrift des Österreichischen Ingenieur- und Architektenvereins,* Vol. 85, July 21, 1933, pages 161-163. For most non-ferrous metals riveted joints have been replaced by welded ones. Welding of Cu, Al, Ni, Ag is considered including that of stainless steels which are here dealt with since fusion welding of these steels deviates considerably from that of common C steels. GN (11c)

Electric Welding in Manufacturing Gas Producers (Die Elektroschweissung im Gaserzeugerbau) Walter Kirnich. *Die Elektroschweissung,* Vol. 4, Aug. 1933, pages 144-146. After considering various types of defects in gas producers occurring after some time of operation it is shown how such disadvantages are eliminated by electric welding. Construction and welded joints of the water chamber of a Körting rotating gas producer are described at length and contrasted with the former riveted type. Weight as well as costs of construction of such producers could be decreased considerably (amounting to about 25-30%). It is stated that electric welding promoted development of new construction principles of gas producers. GN (11c)

Electrodes for Welding Cast Iron. A. I. Goryachev, P. P. Syromyatnikov & E. A. Alexeev. *Welding,* Vol. 3, No. 7, 1932, pages 3-18 (In Russian). Discordance of results obtained by Shun-Ichi Satoh (*Revue de Métallurgie,* 1930) and of Buchholz (*Die Schmelzschweissung,* 1930) was checked in regard to cast iron deposition on welding. Changing the coating composition by omitting asbestos and adding chalk to the mixture produced soft gray iron deposits. Replacement of carborundum with a mixture of ferro silicon and graphite permits greater utilization of Si. Better results are obtained when consecutive layers of the electrode metal are deposited without an intermediate cooling of the job. The deposited iron becomes more uniform and no whitening of the base is observed. The use of Ni-Cu electrodes produces porous welds with poor physical properties. Analyses of coatings used are given. (11c)

Weldability of Cast Iron. L. K. Bougaev. *Welding,* Dec. 1932, pages 7-8 (In Russian). Points to the lack of proper attention to the type and distribution of graphite inclusions in paper by Goryachev, Syromyatnikov and Alexeev abstracted above. (11c)

Formation of Strains in Welds (La Formation des Tensions dans les Soudures) L. de Jessey. *Revue de la Soudure Autogene,* Vol. 24, July 1932, pages 2554-2555. It is shown that it is possible to reduce the internal stresses by suitable working conditions. In welding the casting is actually heat treated; it then is a matter of studying modifications imparted by such heat treatments. As shown by Portevin, 3 modifications can appear: (1) physico-chemical, (2) structural, (3) common. The third due chiefly to instantaneous difference of temperature between the various points of the same piece, is dealt with. Process of internal stress formation is explained as follows: When a local spot is heated, it expands but the cold portion in the neighborhood does not allow this expansion, therefore tension stresses appear in this cold part. When the heated spot reaches 500°-600° C. the plastic flow phenomenon appears and stresses are partially suppressed. When the metal is allowed to cool, it contracts but it can flow in the reverse direction down to 600° C. temperature which the metal can no longer shrink. Stresses are produced in the reverse direction as previously and increase as the temperature falls. Practically, in order to reduce stresses it is advisable to heat the portion surrounding the weld during the welding operation and to allow the piece to cool as slowly as possible down to 400° C. after the weld is made. Distortions are studied. FR (11c)

Effects of Welding and Protective Flames on the Occurrences in the Welding Arc (Der Einfluss von Schweiss -und Schutzgasflammen auf die Vorgänge im Schweisslichtbogen) H. Münter. *Die Elektroschweissung,* Vol. 4, Aug. 1933, pages 149-151. Considerations on the physical occurrences in the welding arc with special reference to the effect of welding and protective gas flames as used in the Arcogen and Arcatom method. Of prime importance is the chemical composition of the arc gases. In gas flames 2 effects are to be distinguished (1) velocity of gas flow first detrimentally affects the arc (2) the increased temperature of the flame gases is favorable. The flame heats the point of the electrode, evaporates the coating material, therefore, making sufficiently conductive the gas path. High ionization of the welding flame guarantees ignition of the arc without contact of electrode and work piece. A.c. generated by inexpensive welding transformers is most suitable for Arcatom welding method. GN (11c)

X-Ray Determination of Stresses in Welds. John T. Norton. *Journal American Welding Society,* Vol. 11, Nov. 1932, pages 28-29. Discussion. For abstract of paper see *Metals & Alloys,* Vol. 4, May, 1933, page MA 142. TEJ (11c)

Investigation of Electrode Materials for Arc Welding. N. M. Nikitinykh. *Welding,* Aug-Sept. 1932, pages 6-11 (In Russian). A detailed description of properties of deposited metal obtained with bare electrodes and arc welding. Low C steels were used containing 0.10%-5.85% Ni or 0.25-0.56% Si. Low Ni content produced best results in Ni group and 0.25% Si was the best among Si group. (11c)

Investigation of the Quality of Electrodes with Thick LIM Coating. N. M. Nikitinykh. *Welding,* No. 5, 1933, pages 4-7 (In Russian). Welds made with electrodes having a thick LIM coating (*Welding,* No. 12, 1932; No. 1, 1933) were examined for physical properties and were found satisfactory for boiler construction. (11c)

Speed Problem Overcome in Spiral Welding of Pipe. *Steel,* Vol. 91, July 4, 1932, pages 26, 28. A description of a new type of spiral pipe welding machine which automatically forms skelp into a "spiral" pipe and welds the helical seam by electric resistance welding. Steel pipe of 4" dia. and ⅛" wall has been produced at a rate of 12 ft./min. Further developments are expected to raise this speed to 50 ft./min. A complete portable unit mounted on 6 flat cars produces pipe on the job, thereby eliminating the excessive costs of handling and transporting pipe. JN (11c)

Improvement of Quality of Arc-Welded Joints by Means of High-Grade Electrodes (Steigerung der Gütewerte lichtbogengeschweisster Verbindungen durch hochwertige Elektroden) H. Aysslinger. *Mitteilungen aus dem Forschungsanstalten des GHH-Konzerns,* Vol. 2, May 1933, pages 135-140. Although welded joints are now quite widely used for constructions of normal stresses a certain hesitation still exists to extend their application to structures subject to particularly high stresses. This is due to some weak points of electrically welded joints which are summarized as (1) the metallurgical quality of the welded joint, (2) the stresses produced by the welding heat, (3) the influence of the shape of the seam on the strength under endurance stresses. In order to maintain economy and simplicity of welding the third point was not considered as this would involve a subsequent working or machining of the seam. Point one depends on the electrode and method of welding, and here lies the greatest possibility for improving the joint which has led to the employment of coated electrodes which develop gases during welding protecting the melting drop from excess of O and N in the air and also preventing a too fast cooling by the thick layer of slag which is formed. A special electrode (composition not given) was developed by the Gutehoffnungshütte for the particular use with welds of highest quality. In all tests the sample was torn in the material, never in the weld. Bending tests under 180° with thicknesses of 10-40 mm. did not break the samples. Notch-impact tests with 10 mm. boiler plates showed at 200° C., unannealed, an average of 18 mkg./cm.^{2}, annealed, 22 mkg./cm.^{2}. Endurance tensile strength under alternating loads with a 10 mm. plate was reduced by 30-35% if unannealed and by 22% when annealed at 500°-600° C. against the value of the not-welded material. The metallographic examination showed a fine, uniform grain free of pores. The C content in the weld was a little lower than in the material due to burning away part of the C which is, however, of no consequence with respect to strength. It is claimed that welds made with the new electrode will satisfy all claims of a high-grade joint. Ha (11c)

Italian Experiments on Gas and Electric-Welding (Italienische Versuche zwischen autogener und elektrischer Schweissung) *Zeitschrift für Schweisstechnik,* Vol. 22, Apr. 1932, pages 99-104. Experiments in the ship yards of the Cantieri Riuniti dell' Adiatico, Trieste. The times required for the various welding methods with reference to the different sheets (6, 10 and 15 mm.) are given in detail for gas and electric welding. Gas welded seams took 839 min. and the electric-welded seams required 1259 min. total welding time. Costs were 151.86 Lire and 201.26 Lire respectively, i.e. 43% higher in case of electric welding. Electric welded containers were 62.5% and electric welded tubes and flanges were 72% more expensive than gas welded ones. The average of 24 samples yielded 35.94 kg./mm.^{2} (gas) and 33.85 kg./mm.^{2} tensile strength (electric-welding) and 6.2 kg./mm.^{2} and 3.1 kg./mm.^{2} impact hardness respectively. Bending, forging and torsion tests proved the marked superiority of gas welding. The same holds true for pressure tests on tubular and cubic products made by both welding methods. EF (11c)

Curve Flame Cutting Machine (Kurvenbrennschneidmaschine) *Werkstattstechnik,* Vol. 27, Jan. 15, 1933, pages 36-37. A new light and handy automatic flame cutting machine for cutting curved pieces is described and examples of application given. RV (11c)

Repairing Iron Castings with "Gussolit" (Ausbesserung durch Gussolit) *Werkstattstechnik,* Vol. 27, Jan. 15, 1933, pages 34-35. The base metal need not necessarily be in a molten state or heated up. Thus, much lower temperature is sufficient for the process, the casting accumulates materially less heat and the repair job is done in half the time. The acetylene or hydrogen flame hits the surface of the piece at a very acute angle and is, instead, directed more to the Gussolit rod. Instances of repair work are pictured such as motor blocks, compressor frames and high pressure cylinders. Without this new method, scrapping would have been necessary. Distortion can easily be avoided if carried out intelligently. Density and wear resistance of the filling is equal to the base metal. No data on composition of rod is offered. RV (11c)

On the Plain State of Stress in the Flank Seam (Zum ebenen Spannungszustand der Stirnkehlnaht) R. Gran Olsson. *Die Elektroschweissung,* Vol. 4, July 1933, pages 124-125. In continuing his former investigations on the possible stress distribution in flank weld seams (*Der Bauingenieur,* Vol. 13, May 20, 1932, pages 294-297) the author develops some mathematical generalization on this problem. GN (11c)

Repair Welding on a Rolling Mill Steam Engine by Fusion and Electric Welding (Reparaturschweissung an einer Walzenzug-Dampfmaschine mittels Autogen- und Elektroschweissung) V. Obratschay. *Die Schmelzschweissung,* Vol. 11, Sept. 1932, page 205. An exploded valve chamber was repaired by welding; full description. Ha (11c)

Study of Expansion and Contraction in Welding and Gas Cutting (Etude de la Dilatation et du Retrait en Soudure et Oxy-coupage) M. Piette. *Bulletin de la Société des Ingénieurs Soudeurs,* Aug.-Sept.-Oct. 1932, pages 692-696. Paper which was awarded a prize by the French Welders' Association. Distorsions are due to strains which are not relieved through plastic deformation. When strains do not lead to distortions they can often be more dangerous in causing breakages when the metal has poor strength and elongation locally. Following was discussed: (1) General discussion of expansion and contraction. (2) Internal strains. (3) Effect of annealing on strains in welded parts. (4) Effect of hot or cold hammering on strains. (5) Distortions and their causes. (6) Methods for obtaining correct welded parts. (7) Study of fractures. FR (11c)

Oxy-acetylene Construction of Pipe-Lines. *Journal American Welding Society,* Vol. 12, Mar. 1933, pages 18-20. Published by the International Advisory Committee for Carbide and Welding Technique, Geneva. A discussion of welding methods, design data and economical advantages of welded pipe-lines. TEJ (11c)

Welding Rods for Alloy Steels. *Iron & Steel of Canada,* Vol. 15, Sept. 1932, pages 113-114. Classification of various types of electrodes for use in welding Fe and different kinds of steel. OWE (11c)

Welding Wrought Iron. *Industry & Welding,* Vol. 5, Feb. 1933, pages 20-22. The Byers Co. describes welding processes for their special wrought iron. Proper temperature is 2700° to 2750° F. When welding with oxy-acetylene special welding rods must be used; electric arc welding requires higher current densities (about 10%) than other materials. Elastic limit of this weld is 28,000 lbs./in.^{2}. Ha (11c)

Gas Welding Opens New Field. *Industry & Welding,* Vol. 4, Oct. 1932, page 28. Many possibilities in employing gas welding in ornamental work and decorative objects are pointed out. Ha (11c)

The Design and Purchase of Welded Steel Parts. *Industry & Welding,* Vol. 4, Oct. 1932, pages 2-5, 30-31. Describes products of Oilgear Co., Milwaukee, where cast parts have been replaced by welded parts. Design had to be changed to meet particular necessities of welding technique. Appearance, cost and often weight could be improved. Ha (11c)

Welding in the Shovel Business. *Industry & Welding,* Vol. 4, Oct. 1932, pages 6-8. Marion Steam Shovel Co. uses welded dipper handles, gears, motor bases, hand rails, etc. in their steam shovels. Ha (11c)

Welded Bomb Bodies Withstand Impact Tests. *Iron Age*, Vol. 129, Jan. 21, 1932, page 225. Bomb bodies made by welding forge steel nose and tail sections to cylindrical body were tested by U. S. Army. Both longitudinal and circumferential welds withstood the standard hard-surface tests. No difference noted in amount of deformation in bombs dropped from 4000 ft. and those from 5000 ft. VSP (11c)

Milwaukee Builds a Welded Tank of 6,000 Gal. Capacity. *Engineering News-Record*, Vol. 110, May 11, 1933, pages 589-590. Largest tank of this type of all welded construction. Welding practice on this job is reviewed. CBJ (11c)

Welding Research Activities of the Institution of Mechanical Engineers. *Engineering*, Vol. 135, Mar. 10, 1933, pages 277-278. Brief outline of work to be undertaken by Welding Research Committee. Work will deal with mechanical properties of weld metal at various temperatures, corrosion resistance properties of welds, and effect of heat treatment on mechanical properties of weld metal and the desirability of heat treatment for removal of stress. LFM (11c)

A Self-Supporting Welded Steel Roof. *Engineer*, Vol. 154, Nov. 18, 1932, page 518. Description of process of welding a grain elevator roof. LFM (11c)

Electric Welding at the Selby Swing Bridge. *Engineering*, Vol. 134, Nov. 18, 1932, pages 583-584. Describes rapid job of welding done on a bridge carrying 2 main lines of London and North-Eastern Railway. Illustrated. LFM (11c)

Oxy-Acetylene Welding Installation at L. G. O. C. Works. *Engineering*, Vol. 135, Mar. 31, 1933, pages 353-355. Describes equipment and methods used by London General Omnibus Company in overhauling the company's vehicles. LFM (11c)

Welding Research. *Engineer*, Vol. 155, Mar. 10, 1933, pages 253-254. An outline of the plan of research to be undertaken by the Welding Research Committee of the Institution of Mechanical Engineers. The 3 items to be considered are: the mechanical properties of weld metal at various temperatures, corrosion tests to be made on welds, the effect of heat treatment on the mechanical properties of weld metal and the desirability of heat treatment for the removal of stress. LFM (11c)

Preliminary Specifications of the German Railway Co. for Welded Vehicles. (Vorläufige Vorschriften der Deutschen Reichsbahn- Gesellschaft für geschweisste Fahrzeuge in Anlehnung an DIN 4100.) *Die Elektroschweissung*, Vol. 4, May 1933, pages 89-94. Specifications are given and discussed under the following headings: (1) General, (2) materials, (3) welding methods, (4) rules for the calculation of fusion weld seams, (5) admissible stresses in seams, (6) rules for structural design, (7) testing welders, (8) admission test of contractor, (9) erection, (10) supervision of construction. GN (11c)

Supporting Plates Electrically Welded on Tube Ends. (Elektrisch angeschweisste Stützbleche an Rohrenden.) *Die Elektroschweissung*, Vol. 4, Apr. 1933, pages 71-75. Supporting plates were welded-on in various fashions with variable seam lengths. Tensile, compression and bending tests were made. The principal results are: (1) The method commonly used in shipbuilding for welding-on supporting plates to tubes is the poorest, (2) by using a special arrangement of attaching the plates to the tubes the tensile strength of the joint could be increased considerably, (3) the side angles of the supporting plates can be made essentially smaller than is common, (4) the cross-like arrangement of the plates results in a higher strength in tension and compression, (5) the weakest areas in the welding construction are the ends of the supporting plates due to the notch effects occurring there. GN (11c)

Application of Electric Welding in Building American Cruiser "New Orleans." (Die Elektroschweissung beim Bau des amerikanischen Kreuzers "New Orleans.") *Die Elektroschweissung*, Vol. 4, Feb. 1933, pages 35-36. Discusses application of electric welding to various parts of the above mentioned cruiser. The specifications of the welding rods used are dealt with. GN (11c)

Ammonia Cracking. *Electrician*, Vol. 110, Mar. 3, 1933, page 310. Electrical method of generating hydrogen for welding consists of passing anhydrous ammonia through heat exchanger, into tube containing catalyst, over an electrical heater, over more catalyst, through inner tube of heat exchanger. System is made automatic so that ammonia supply is shut off when pressure of cracked gas rises to a predetermined value. CBJ (11c)

Welding Instruction in Engineering Schools. A. F. Davis. *Journal American Welding Society*, Vol. 12, Mar. 1933, pages 13-14. A survey made by author indicates that heads of engineering schools are extremely sympathetic toward the inclusion of courses on welding in their curricula. Two factors which are limiting the instruction given are: (1) Lack of funds to equip laboratories properly, (2) lack of adequate text material. TEJ (11c)

Aluminum Welding for Pipe Line Construction. (Aluminiumschweissung im Rohrleitungsbau.) *Der Autogen Schweisser*, Vol. 5, Jan. 1933, pages 5-6. Increasing use of Al for heating and cooling coils especially in chemical plants is pointed out. Methods and materials used for Al welding are discussed. Attention is focussed on fusion welded Al pipe coils tested at 60 atmospheres. Kz (11c)

Electric Welded Ship Construction in Germany. Burkhardt. *Welding Journal*, Vol. 30, Mar. 1933, pages 70-71. Abstract of paper read before the German Society of Electric Welding, June 15, 1932. Doubts as to the strength of welded joints do not exist in German ship yards, therefore welded construction is preferred. 8 to 10% of weight is saved by this type of construction. Some problems encountered and their solutions are cited. TEJ (11c)

Industrial Plant Saves by Electric Welding. R. J. Collins. *Electrical World*, Vol. 110, Feb. 18, 1933, pages 220-223. Arc welding in an average metal-working plant can be classified as follows: (1) General repairs; (2) building new equipment; (3) building jigs and fixtures; (4) experimental design and construction; (5) production building. CBJ (11c)

The Application of Welding to Machine Tool Equipment. A. H. Collins. *Welding News*, Vol. 3, Oct.-Dec. 1932, pages 53-54. Welding methods used by Sunshine Harvester Works, Sunshine, Victoria, for construction of machining jigs are described. Welded jigs are, for same weight, stronger, more rigid and better able to resist abuse. Ha (11c)

Stress Distributions in Fusion Joints at Plates Connected at Right Angles. E. G. Coker & R. Russell. *Engineering*, Vol. 135, Apr. 21, 1933, pages 442-443. Includes discussion. Short abstract of paper read before the Institution of Naval Architects, April 5, 1933. LFM (11c)

Welding in the Construction of Naval Aircraft. Edw. W. Clexton. *Journal American Welding Society*, Vol. 12, Feb. 1933, pages 9-10. Address before 33rd Annual Convention, International Acetylene Association, Philadelphia, Pa., Nov. 1932. A discussion of the present status of welding in aircraft construction. Welding process has played a major role in development of aircraft. TEJ (11c)

Shrinkage Stresses in Welded Steel Structures. (Schrumpfungen an geschweissten Stahlbauten.) Dörnen. *Bautechnik*, Vol. 11, Feb. 3, 1933, page 22. During welding, shrinkage stresses are set up. A first account of results of shrinkage measurements still in progress at the Stahlbauanstalt Dörnen in coöperation with the German federal railway is given. GN (11c)

Oxyacetylene Construction of Apparatus and Containers. *Journal American Welding Society*, Vol. 12, Feb. 1933, pages 27-29. Published by the International Advisory Committee for Carbide and Welding Technique, Geneva. Superiority of the oxy-acetylene welded seam is due to its permanence and ductility. Methods of welding, the technique of welding, data for calculations and results of tensile and impact tests are discussed. TEJ (11c)

Welding of Pressure Vessels. *Journal American Welding Society*, Vol. 12, Feb. 1933, pages 13-15. Contains some recent additions to the A. S. M. E. Boiler Construction Code with special reference to welded attachments of nozzles and outlet connections. Includes a Foreword by C. W. Obert, Chairman, Welding Conference Committee, American Welding Society. Some sketches of acceptable types of fusion welded nozzle construction are shown. TEJ (11c)

American Boiler Plants. (Amerikanische Dampfkesselanlagen.) Friedrich Schulte. *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 14, Feb. 1933, pages 35-39. The paper especially refers to the American specifications of boiler welding and the welding equipment of the Babcock & Wilcox Co. Processing of boilers by welding is described. GN (11c)

A New Welded Bridge in Dresden. (Eine neue geschweisste Strassenbrücke in Dresden.) Fr. Reinhold. *Bautechnik*, Vol. 11, Mar. 28, 1933, pages 157-169. Detailed discussion of welding work performed in constructing the described bridge. As compared with other designs weight and cost could be considerably lowered. GN (11c)

The Governing Factors of the Performance of Mild Steel Welded Electrodes. Bela Ronay. *Journal American Welding Society*, Vol. 12, May 1933, pages 22-23. Describes a method used for the determination of electrode performance. Magnetic analysis was used to determine the chemical composition and microstructure of metallic electrodes as associated with satisfactory electrode performance. A study of drop deposition led to the development of the Arcronograph, an electrical instrument that automatically integrates and records the time relationship of the formation periods and the short circuit periods of each drop throughout the entire consumed length of each electrode as a function of the potential conditions that exist during each corresponding period. Uniformly performing high grade electrodes require: (1) chemical composition held within reasonably close limits; (2) freedom of impurities, permitting the presence of a small amount of non-metallics uniformly distributed; (3) the grain structure must be uniform, the material must be fully recrystallized; (4) the covering of covered electrodes must perform to permit the required uninterrupted minimum formation period-transfer period ratios, the Arcronograph ratings, that were found necessary for satisfactory performance. TEJ (11c)

All-Welded Compressed Air Receivers. *Welder*, Vol. 4, Jan. 1933, pages 23-24. Brief description of a 30 ft. long tank for 140 lbs. pressure; tested with 280 lbs. Ha (11c)

Fusion Welding at Renfrew. *Welder*, Vol. 4, Oct. 1932, pages 12-16. Babcock & Wilcox, Ltd. by using mechanically controlled electric arc welding vessels produce regularly quality of workmanship superior to riveting. Mechanical and X-ray tests carried out on such vessels are described. Ha (11c)

Improved Electric Welding of Aluminum. (Verbesserte elektrische Aluminium-Schweissung.) *Technische Blätter der deutschen Bergwerkszeitung*, Vol. 23, Apr. 23, 1933, page 239. After briefly discussing difficulties encountered in electro-welding Al a new Al welding electrode is described, developed by the Hermann Fliess Co., Duisburg. The new electrode has a coating which is not hygroscopic and possesses good mechanical properties. In using this electrode the piece to be welded need not be pre-heated. The coating protects the metal from oxidation, thus avoiding the detrimental formation of Al_2O_3. The coating forms a thinly liquid slag which is easily removed. Welds thus made show the tensile strength of the parent metal. Metallographic examinations show a gradual transition from weld to parent metal. GN (11c)

High-Speed Arc-Welding Sheet Metal. *Sheet Metal Worker*, Vol. 23, Aug. 1932, page 350. Describes procedure followed in making T-joints, elbow sections, etc. of ¼" plate cut by a shear, bolted together and then welded. Ha (11c)

Aluminum Coated Welding Rods. (Schweissdrähte mit Aluminiumüberzügen.) *Technische Blätter der deutschen Bergwerkszeitung*, Vol. 23, Feb. 5, 1933, page 77. Alloyed Al rods are unfit due to the formation of Al_2O_3 inclusions. However, investigations of the Krupp works showed that Al coated rods made according to the diffusion process do not show this disadvantage. Welds free from such inclusions and well deoxidized are thus obtained. GN (11c)

Gas Cutting of the Periphery of Water Turbine Propellers (Das Autogene Schneiden des Umkreises von Wasserturbinen-Schaufeln). *Die Schmelzschweissung*, Vol. 11, Dec. 1932, page 257; from *Revue de la Soudure Autogene*, Jan. 1932, pages 2433-2434. The thickness to be cut varied between 55 and 110 mm., cutting was done automatically, each propeller required a cut of 3.2 m. length, the average cutting speed was 7.1 m./hr. For the 7.1 m. 7030 l.O were consumed for cutting, 500 l.O for preheating, 300 l.C_2H_2 for preheating. It is said that mechanical cutting would have been considerably more expensive. Ha (11c)

Developments in the Construction of Submarines. G. C. Weaver. *Marine Engineering & Shipping Age*, Vol. 38, Feb. 1933, pages 44-47. Details about the rolling and welding of plates for the new U. S. submarine Cachalot are given. Kz (11c)

Oxy-Acetylene Cutting Applied to Cast Iron. George L. Walker. *Machinery*, Vol. 38, Apr. 1932, pages 572-575. First applied to opening tap holes in blast furnaces. Inserting steel rods in pipe increases action, and is known as oxygen lance method. It is used for cutting large sections of cast Fe or steel. Explains theory of this action. A steel rod is often introduced into flame of torch at the cast Fe. A strip of steel may be laid on the cast Fe. Considers cutting tips, preheating flame, oxygen pressure, manipulation of the torch, cutting methods and applications of the process. RHP (11c)

Weld Here—and Save Half. James Winston. *Industry & Welding*, Vol. 5, Feb. 1933, pages 7-9. A few tables are given showing length of weld required for a certain load when weld has to replace screwed joints. Detailed instructions should be given to shop for each individual weld. Ha (11c)

How We Adopted Welding as a Tool in Heating Work. R. D. Williams. *Domestic Engineering*, Vol. 140, Dec. 1932, pages 43-44, 60. Description of welding experiences in heating and piping installation. Kz (11c)

A Unique Repair. A. Young. *Welder*, Vol. 4, Mar. 1933, pages 15-18. Arc welding procedure used in repairing a broken Mn steel railway crossover. TEJ (11c)

Field Welding of Tanks. D. C. Wright. *Welding Engineer*, Vol. 18, Apr. 1933, pages 14-18. Laying out of the work, use of proper equipment and tools, selection of personnel, types of welds used profitably in field work, etc. are discussed exhaustively. Ha (11c)

Welding & Cutting & Riveting (11c-d)

Riveting and Welding of Aluminum. F. V. Hartman & C. M. Craighead. *Metal Stampings*, Vol. 5, Sept. 1932, pages 545-548, 568. Al rivets should ordinarily be of the same alloy as the sheets that are joined. Most commonly used alloys are 2S, 3S, and 17S. Rivets of 2S and 3S are always driven cold. Rivets of 17S should be in the heat-treated condition, and are driven cold in sizes up to 7/16 in. diam. When less than ⅛ in. diam. they are often driven in the fully heat-treated condition. Between ⅛ in. and 7/16 in., they are driven immediately after heat treatment and before they have age hardened. When 7/16 in. or larger, 17S rivets must be driven hot. This consists of heating the rivets to 940°-960° F., and driving them with a minimum lapse of time. Al rivets require considerably more force for heading than is required for hot steel rivets. Most generally satisfactory method of welding Al is by the oxy-hydrogen or oxy-acetylene methods. Metal ⅜ in. thick or thicker should be preheated. Fluxes used are usually mixtures of salts, such as chlorides, fluorides, and sulphates of P, Li, Ca, and Na. Welding wire of pure Al should be used for commercially pure Al and 3S alloy, while 17S and 51S should be welded with an alloy of 95% Al and 5% Si. MS (11c-d)

Welded versus Riveted Construction. G. M. Buchanan. *Welder*, Vol. 4, Feb. 1933, pages 16-18. A few examples show the comparative costs of the 2 systems. In order to arrive at proper figures the welding job must be designed for welding and not based on the riveted job. This will often show the possible saving in welding. Ha (11c-d)

WORKING OF METALS & ALLOYS (12)

Shop Treatment of Aluminum. (Werkstattsbehandlung des Aluminiums.) R.
PLÜCKER. *Die Eisenbahn Werkstätte,* Vol. 41, June 5, 1933, pages 95-96.
Instructions are furnished on bending, cold working, drilling, planing, filing,
1 grinding, polishing, pickling, sand-blasting, paint coating, spraying, Jirotka treating, soldering, welding and electrolytic welding according to Peukert. WH (12)

Ford Improves Metal Fabricating Processes. E. F. Ross. *Steel,* Vol. 90, June 6, 1932, pages 27-29. First article. An introductory discussion of the many new methods and processes lately developed by the Ford Motor Co. for the more efficient working of metals. All types of electric welding have been greatly improved by the installation of automatic equipment, forging methods have been improved and a new method, known as "die typing," developed for the production of dies. Improvements have been made also in the heating and heat treatment of metals, in pickling methods, and in the remelting of scrap. JN (12)

2 Melting & Refining (12a)

Deoxidation of Red Brass with Phosphorus. (Zur Desoxydation des Rotgusses mittels Phosphors.) E. R. THEWS. *Die Metallbörse,* Vol. 22, Aug. 13, 1932, pages 1037-1038; Aug. 20, 1932, page 1069. Whether P chemically deoxidizes Zn and Sn oxide in the melt or promotes a mechanical separation due to rendering the bath more liquid has not yet been settled. Thews states that the metal stream is protected against oxidation during casting due to volatilizing P whose vapor forms a thin "gas hose." The quantities of added P are so small that the purifying effect cannot be ascribed to a mere chemical reduction of Sn and Zn oxide. The viscous slag consists largely of metals which join the melt when P is added. Thews advises the
3 following order of melting down the various metals: Cu-P scrap, Zn, Sn, P. Pouring is carried out after 2-3 min. The amount of P for final deoxidation is .015% P, the critical limit being .20% above which no sound castings are secured while ladle, linings and mold are strongly corroded. 13 references. EF (12a)

Refining Reaction in Steel Making. (Les reactions d'affinage dans la fabrication de l'acier.) MARCEL GUEDRAS. *Aciers Spéciaux, Métaux et Alliages,* Vol. 7, Nov. 1932, pages 413-414. Metallurgical reactions are treated as physico-chemical problems in more general way. GTM (12a)

Dephosphorization of the Steel Bath. (Zur Entphosphorung des Stahlbades.) H. O. S. HIMMELSTJERNA. *Archiv für das Eisenhüttenwesen,* Vol. 6, May 1933, pages 471-475. Time-temperature heating curves of mixtures of
4 Fe_2P with FeO, Fe_2O_3, CaO, Al_2O_3 and MnO were used to determine the heats of formation of the respective iron-phosphates formed. By means of similar heating curves of mixtures of the various oxides and phosphates, the power of the oxides to bind P_2O_5 and thus exert a dephosphorizing effect on the steel bath was likewise determined. The oxides were arranged in the following order in this respect, increasing from left to right, Fe_2O_3, Al_2O_3, FeO, ZnO, MnO, MgO, CaO. SE (12a)

Some Factors Affecting the Cleanliness of Steel Castings. C. H. HERTY, JR., C. F. CHRISTOPHER & M. W. LIGHTNER. *Foundry Trade Journal,* Vol. 47, Aug. 25, 1932, pages 107-108. See *Metals & Alloys,* Vol. 4, Aug. 1933, page MA 261. OWE (12a)

5 **Open-Hearth Metallurgy in 1932.** C. H. HERTY, JR. *Blast Furnace & Steel Plant,* Vol. 21, Jan. 1933, pages 25-27. Reviews developments in deoxidizers particularly Mn-Si alloys, FeO content of slag, determination of inclusions, grain size, effect of slow working of blast-furnaces on quality of pig-iron, intermittent operation of open-hearth furnaces, and alloy contamination. MS (12a)

1 **Velocity and Equilibria of the Carbon Reaction During the Making of Liquid Steel. (Über die Geschwindigkeit und die Gleichgewichte der Kohlenstoff-reaktion bei der Herstellung flüssigen Stahles.)** H. Schenk. *Die Metallbörse,* Vol. 22, June 25, 1932, pages 802-803. Refers to paper before Deutsche Bunsengesellschaft für angewandte und physikalische Chemie, Essen. Difficulties in checking on reaction $FeO + C = Fe + CO$ due to rapid degasification of sample taken are emphasized. Thus the reaction velocity constants experimentally determined vary between 100 and 2,000. A piece of Al placed into the test spoon was supposed to spontaneously reduce all FeO. The original O_2 quantity is found by determining Al_2O_3. The results were interpreted under the assumption that equilibria conditions between polymeric cementite on one hand and Fe and C on the other hand exist. The equilibria constants derived from the velocity constants are around 90 and show moderate temperature dependence. EF (12a)

2 **Manufacture of Cast Iron in Electric Furnace.** Masao Sano. *Suiyokwai-shi,* Vol. 7, Nov. 25, 1932, pages 132-141. A study was carried out to manufacture high quality cast iron by melting scrap of cast iron in a Heroult acid electric furnace, whose capacity was 30-100 kgs. The hearth was made with a mixture of silica sand and 5% fire clay. Thus author obtained cast iron of required content of Si by regulating temperature in furnace, and employing slag whose content of silica was higher than 50%. S content could be easily decreased to 0.04% by making content of CaO in slag 20-30%. Ferro-manganese was added to increase Mn content and its loss was prevented by charging charcoal as reducing agent. HN (12a)

3 **Electrical Resistance Alloys.** W. F. Randall. *Electrical Review,* Vol. 111, Sept. 16, 1932, pages 390-391. Discusses manufacture. Use of induction furnace for melting Ni-Cr alloys has made possible the manufacture of an alloy approaching very closely to binary purity. Most suitable raw materials are Cr made by the Thermit process and Mond Ni. Stirring in the high-frequency furnace insures homogeneity of the metal bath. With the induction furnace it is possible to charge up and cover completely with a slag of required composition, thus preventing absorption of gases from the air. This obviates addition of Mn and C, necessary in other methods. To obtain ingots which will forge and roll satisfactorily, a definite superheat must be adhered to, a steady rate of pouring must be maintained and the ingot-mold must be designed to discourage radial crystallization. Ingots require care during hot working. Absence of C improves working qualities. To prevent deleterious effect of sulphurous atmospheres, alloys should be preheated in a muffle furnace or in electrically heated furnaces. MS (12a)

4 **Making Cast Iron in Electric Furnaces. (La fabrication de la fonte au four électrique.)** E. Ronceray & R. Sevin. *Journal du Four Electrique,* Vol. 42, May 1933, pages 166-171. Making cast Fe from steel scrap in an electric furnace is justified in foundries only under exceptional conditions of the market. Since the war practically no iron was made in such a way. Finishing molten blast furnace Fe in electric furnaces to definite specifications pays for itself. Societe des Hauts-Fourneaux de Saulnes installation of 12 ton electric furnace used for the purpose is described. Several grades of Fe made are sold to the foundries for direct remelting. Furnace stands about 100 heats on one roof consuming 2.5-4.5 kg. of electrodes and 350-450 KWH per ton of finished iron. JDG (12a)

5 **New Toussaint-Levoz Converter. (Le nouveau Convertisseur Toussaint-Levoz.)** T. Levoz. *Revue de Fonderie Moderne,* Vol. 26, Sept. 10, 1932, pages 283-286. Some more operating experiences with the new converter with lateral air supply are given (for description of converter see *Revue Fonderie Moderne,* Vol. 26, June 25, 1932, page 203). It is claimed that the conversion in the new converter goes on more regularly with a minimum of over-oxidation of the iron, that a better quality of steel than ever before can be produced at a much lower price as repairs and waste are greatly reduced. Operating practice of a few French steel works is briefly described. Ha(12a)

Removal of Absorbed Gases from Aluminum Alloys by Treatment with Nitrogen-Chloride Mixtures. (Zur Entfernung absorbierter Gase aus Aluminiumlegierungen durch Behandlung mit Stickstoff-Chloridmischungen.) *Die Metallbörse,* Vol. 22, Oct. 22, 1932, page 1358. A brief literature review on elimination of gases in Al alloys with particular emphasis on advantageous utilization of mixtures of volatile chloride and nitrogen according to Tullis, Rosenhain, Grogan & Schofield. EF (12a)

Investigations on the Preparation of Aluminum-Barium Alloys. (Untersuchungen über die Herstellung von Aluminium-Bariumlegierungen.) E. ALBERTI. *Metall und Erz,* Vol. 30, June 1933, pages 231-233. The Ba used was prepared by the alumino-thermit process and was 99.0-99.3% pure. The Al contained .21% Fe and .22% Si. Several methods of alloying were tried. When Ba is immersed in molten Al at 900°C. and stirred with a Mg rod the resulting alloy contains many oxides and nitrides. When $BaCl_2$ and KCl are used as a protective covering and flux the results are somewhat better with alloys containing up to 7% Ba. Vacuum melting cannot be used as the Ba volatilizes. In the alumino-thermit process according to the equation $3BaO + 2Al = Al_2O_3 + Ba$ not enough heat is generated to melt the alloy. Furnishing additional heat by external means was not successful. However the alumino-thermit process according to the equation $3BaO_2 + 4Al = 2Al_2O_3 + 3Ba$ was successfully carried out. The Ba alloys with the excess Al and good separation between alloy and slag was obtained. The alloy was made in crucibles lined with MgO. The mixture $3BaO_2$:1 BaO: 1.5 Al gave the best results, producing alloys containing 46-59% Ba. These alloys still contained some oxides. The best process was developed by using a flux of $BaCl_2$ or 83% $BaCl_2$ + 17% BaF_2 with BaO and Al, the flux dissolving the excess BaO and Al_2O_3. Good separation of alloy from flux is obtained. In alloys containing more than 20% Ba a chemical compound rich in Ba is formed which crystallizes out at 900° or lower. 500 g. flux and 200 g. Al were melted together and heated to 1000°-1100° C. and then powdered BaO was stirred in. Enough BaO should be added to make the slag viscous. CEM (12a)

Distribution of Phosphorus between Iron and Lime—Containing Iron Phosphate Slags. (Die Verteilung des Phosphors zwischen Eisen und Kalkhaltigen Eisenphosphatschlacken.) W. BISCHOFF & E. MAURER. *Archiv für das Eisenhüttenwesen,* Vol. 6, Apr. 1933, pages 415-421. Slags containing only CaO, FeO, and P_2O_5 were considered; ordinary basic steel making slags carrying also MnO and SiO_2 were left for further study. CaO, P_2O_5, FeO, and Fe were melted in BeO and in C crucibles and the distribution of phosphorus between iron and slag at various temperatures determined by analysis. With lime-free slags and with P contents up to 4% the ratio of P_2O_5 in the iron-phosphate slags to P in the iron was 5.8. This distribution ratio was little affected by temperature. With the addition of CaO there was an appreciable increase in this ratio which reached a maximum at 40% CaO. In the presence of lime the distribution ratio was decidedly reduced with rise in temperature, this effect being most marked at 40% CaO content. SE (12a)

Metallurgy of the Thomas Process. (Beiträge zur Metallurgie des Thomasverfahrens.) P. BARDENHEUER & G. THANHEISER. *Die Naturwissenschaften,* Vol. 21, May 26, 1933, pages 386-389. At regular intervals, samples were taken from the charge and submitted to chemical analysis. A diagram is presented showing the changes of the C, P, S, Mn, Si content on one hand and the presence of N_2 and O_2 on the other in relation to operation time. EF (12a)

Chemical Reactions in the Open-Hearth Furnace. (Ueber die metallurgischen Vorgänge beim Siemens-Martin-Verfahren.) P. BARDENHEUER. *Stahl und Eisen,* Vol. 53, May 11, 1933, pages 488-496. Using a 30 ton basic open-hearth furnace the change in concentration of C, Mn, S, P, N_2 and O_2 in the bath and CaO, SiO_2, P_2O_5, FeO, MnO, and MgO in the slag during the working of the heat was determined. The results are shown in numerous graphs. The oxygen content only began to rise sharply when the carbon had come down to about 0.2%. An unpublished report of the Eisenforschung Institute is stated to indicate that in duplexing basic Bessemer steel the N_2 content may be reduced to ½ to ⅓ by a short boil in the openhearth. The bad effect of rusted scrap can be overcome by melting down higher in carbon and longer boiling. Adding Mn tends to reduce the O_2 in the bath because FeO is displaced by MnO and MnO is less soluble in steel than FeO. A rise in temperature from 1600°-1700° C. will cause the Mn in the bath to go up from a value of 0.50% to 0.75%, through the effect of temperature in lowering the equilibrium constant $K_{Mn} = \frac{(MnO)\ [Fe]}{(FeO)\ [Mn]}$ and also for the following reason. Rising temperature causes more CaO to go into solution in the slag; this CaO combines with SiO_2 which had previously been combined with MnO; the MnO thus released tends to cause a pickup in the Mn content of the bath. The reducing effect of the Mn addition at the end of the heat caused an appreciable rise in P. Some S reduction was obtained; this occurred as the O_2 in the slag came down and the ratio CaO-SiO_2 went up. In deoxidizing with Mn there is danger of contaminating the steel with MnO, if the Fe-Mn is added just before tapping. FeO from the slag will rush into the strongly reduced bath; this is converted to MnO but there may be no time for MnO to be reduced to Mn. There is also danger of introducing a good deal of gas with Fe-Mn and other ferro-alloys, as these contain about 80 cc. of gas per 100 g. of alloy. The working of basic and acid open-hearth heats are also compared. In the acid process the role of Mn in the basic process is taken over by Si. The conditions for the reduction of Si from the slag are a high SiO_2 content, a fluid slag, high temperature, low O_2 content of the bath and FeO content of the slag, and a sufficient reducing action of the C. SE (12a)

Finishing the Heat of Steel. I-VIII. J. H. HRUSKA. *Blast Furnace & Steel Plant,* Vol. 20, Sept. 1932, pages 705-707; Oct. 1932, pages 771-773; Nov. 1932, pages 838-840, 856; Dec. 1932, pages 894-895, 904; Vol. 21, Jan. 1933, pages 45, 64; Feb. 1933, pages 107-109; March 1933, page 151-153; April 1933, pages 213-214, 221. Discusses ingot phase in steel making. Deals with oxygen content of commercial ingot-steels; principles of deoxidation; deoxidation by various agents; theory of teeming; fluidity and density of molten steel; pouring temperatures and rates; control of pouring rates by ladle stoppers; nozzle erosion; and pouring temperatures for various grades of steel. (12a-b)

Casting & Solidification (12b)

Casting Shrinkage and Compensation within the Cavity. J. CAMPBELL. *Dental Cosmos,* Vol. 75, May 1933, pages 434-441; June 1933, pages 551-560; Aug. 1933, pages 758-767. Discusses many factors which must be considered in making satisfactory castings, including wax, investment, casting technique, and how certain procedures may be used to compensate for the unavoidable solidification shrinkage of gold. Suggestions are made for further researches. OEH (12b)

Fourth Report on the Heterogeneity of Steel Ingots. A Joint Committee of the Iron & Steel Institute and the National Federation of Iron and Steel Manufacturers to the Iron & Steel Industrial Research Council. Published by the Iron & Steel Institute, London, 1932. 267 pages. Price 16s. See *Metals & Alloys,* Vol. 4, Feb. 1933, page MA 43. JLG (12b)

Developments in Aluminum Alloy Die-casting. *Machinery,* London, Vol. 42, May 4, 1933, pages 121-123. Machines for pressure die casting, operating by compressed air at 400 lbs./in.^{2} pressure, are discussed. Heat treatment of Al alloy castings, varying to suit the different alloys, is carried out in electrically-operated furnaces. On Y-alloy the treatment consists of heating for 6 hours at 500°C. followed by quenching in boiling water. Al alloy pistons are heated for 2 hours at 510°-520°C. and quenched in water, followed by further heating for 4 hours at a temperature of 200°C. and cooling in air. For the dies is used: close-grained cast iron, semi-steel with a small Cr content, Cr-V steel, W-Cr steel. Steels for pressure dies are heat treated to give a Brinell reading of 350-380. For small cores 18-22% W steel and sometimes steel with a small percentage of Co is used. Kz (12b)

Ingot Molds and Teeming of Steel (Kokillen und Giessen im Stahlwerk) A. Ristow. *Stahl und Eisen,* June 15, 1933, pages 617-627. A detailed comparison of the dimensions of German and American square, oblong, and big-end up hot-topped ingot molds, and of teeming practice. The comparisons are presented in 15 graphs and 1 figure. The discussion contains a comparison of German and American deoxidation practice and an account of the use of big-end up ingot molds. SE (12b)

The Casting of Two Huge Doors of Bronze. F. H. Landolt. *Metal Industry,* N. Y., Vol. 31, Mar. 1933, page 90. A short description is given of successful preparations for making two 5,000 lb. castings 22 ft. x 13½ ft. x ⅜ in. the faces of which were of highly ornamental design. PRK (12b)

Wall Thickness Sensitivity and Accuracy of Castings of unalloyed and alloyed Cast Iron (Wandstärkenempfindlichkeit und Treffsicherheit bei unlegiertem und legiertem Gusseisen) E. Piwowarsky & E. Soehnchen. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, May 6, 1933, pages 463-468. Wall thickness sensitivity of cast iron is defined as the tendency to give entirely differing structures in castings of greatly differing wall thicknesses and thus to show considerable differences in mechanical properties; this often results in cracking. Tests were made which permit stating that this wall thickness sensitivity and consequently the assurance of obtaining a casting of desired quality, can be influenced by proper mixing of the raw materials and alloying. An increase in the content of C, Si and P increases the sensitivity, Al in small amounts has only little improving action. Ni increases the insensitivity against differences of wall thickness; the same effect is due to Cr and Mo but apparently only with additions up to 0.5%. Attention is called again to the fact that samples cast with an average wall thickness of the casting by no means give representative results; this test should be supplemented by a test for wall thickness sensitivity. The American practice of casting graded bars is recommended. 22 references. Ha (12b)

Makes Die Castings at High Pressure With Low Melting Temperature. F. L. Prentiss. *Iron Age,* Vol. 129, June 9, 1932, pages 1246-1247. Describes method practiced by Schultz Die Casting Co., Toledo, in the manufacture of Zn base die castings. With low casting temperature improved structure of metal, more uniform product and a closer dimensional accuracy is obtained. Die casting machines of a new design are used. VSP (12b)

Development of Best Dimensions of Ingots and Ingot Molds for Railroad Tires. Yu. V. Prokhorov. *Domez,* No. 11, 1932, pages 1-22. (In Russian.) A detailed study of the advantages of ingots suitable for production of single tires and those which after cutting can be forged into several tires. The first, weighing 330 kg., furnished inferior tires largely on account of pipe. The use of big end up ingot molds with a hot top furnished ingots better in all respects. (12b)

Present Status of the Study of the Castability of Metals and Alloys (État Actuel de l'Étude de la Coulabilité des Métaux et Alliages) A. Portevin. *Bulletin de l'Association Technique de Fonderie,* Vol. 16, Aug. 1932, pages 422-427. Paper presented at the World Foundry Congress, Paris, Sept. 1932. Coulability means castability or flowability and is dependent on many factors, such as (a) the nature and temperature of the mold; (b) the pouring temperature and calorific properties of the metal; (c) the composition of the alloy. Castability is anisothermal, but fluidity is isothermal and the inverse of viscosity. The terms castability and fluidity are not synonymous. A spiral castability test enables one to choose the most castable alloys and the proper sand mixtures as well as to note changes in the metal. 4 references. WHS (12b)

Finishing the Heat of Steel. Pt. XI-XII. J. H. Hruska. *Blast Furnace & Steel Plant,* Vol. 21, May 1933, pages 264-265; June 1933, pages 324-325; July 1933, pages 372-373; Aug. 1933, pages 422-423. Deals with pouring of forging ingots weighing more than 50 tons; pouring with tun dishes; cascade pouring; and advantages, disadvantages, and practice of bottom pouring. Includes bibliography. MS (12b)

Characteristics of Basic Open-hearth Ingots. Isamu Kohira. *Tetsu-to-Hagane,* Vol. 18, June 1932, pages 548-562. (In Japanese.) Rimmed steel and killed steel ingots were used. Their external characteristics are pointed out, and their internal characteristics are also discussed. These variations are attributed to the process of solidification rather than to the chemical composition of ingots. For example, killed ingot, which is less disturbed by gas during solidification than the rimmed ingot, has a larger area of dendritic structure and a smaller area of free crystal. The formation of the so-called V and Λ type segregations is explained by the contraction groove which is formed at the time of solidification. The size and amount of columnar blow holes at the outer part of rimmed ingot depend on the casting velocity, being mitigated by the slowness of casting velocity. The gases in blow holes are mixture of H and N with traces of CO and O. The blow holes in soft steel ingots can be pressed down completely. ST (12b)

Pipes in Small Cast Iron Parts (Lunker in kleinen Gusseisenstucken) H. Kalpers. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 53, Oct. 2, 1932, pages 393-394. See "The Draw in Small Castings," *Metals & Alloys,* Vol. 4, Jan. 1933, page MA 17. GN (12b)

Ingot Molds (Stahlwerkskokillen) L. Jacob. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, June 4, 1933, pages 213-215. The paper considers the various factors influencing the durability of ingot molds. The durability essentially depends on the construction of the mold. The mold should be so constructed as to show a uniform temperature distribution upon casting the ingot and during cooling. The molding sand used should be plastic and highly permeable to gases. Of great importance for processing good molds is the making of the cores which are suitably made in iron core boxes. The points to be observed in molding are considered. To attain good molds the quality of the facing material used should not be neglected. As to the chemical composition a hematite cast Fe with 3.8-4.2% total C, 3.2-3.9% graphite, 2.2-2.5% Si, max. .80% Mn, max. .09% P and 0.03% S seems most suitable. The structure of such an Fe should show a fine lamellar pearlite with rather much free ferrite. The hardness should not exceed 120 Brinell. Composition of melting charges is given. Precautions in using ingot molds are dealt with. GN (12b)

Brass Press-Casting Method. (Das Messing-Pressgussverfahren.) Brunkow. *Die Giesserei,* Vol. 19, Nov. 25, 1932, page 483. See *Metals & Alloys,* Vol. 4, Sept. 1933, page MA 294. Ha (12b)

Mold Materials for Non-ferrous Strip Ingot Casting. G. L. Bailey. *Metal Industry,* London, Vol. 41, Sept. 16, 1932, pages 279-280; *Engineering,* Vol. 134, Oct. 21, 1932, pages 490-492; *Engineer,* Vol. 154, Sept. 23, 1932, page 309; *Rolling Mill Journal,* Vol. 7, No. 3, 1932, pages 137-138, 146; *Foundry Trade Journal,* Vol. 47, Sept. 15, 1932, pages 154-156; Sept. 22, 1932, pages 173-177; *American Metal Market,* Vol. 39, Sept. 16, 1932, page 6; Sept. 17, 1932, pages 6, 8; Sept. 20, 1932, page 4. Abstract of paper before a joint meeting of the Iron & Steel Institute and the Institute of Metals, Sept. 1932. See *Metals & Alloys,* Vol. 4, June 1933, page MA 184. MS+LFM+Ha+OWE+DTR (12b)

Casting of a Large Cover in Green Sand (Ueber das Giessen eines grossen Deckels in nassem Sande) A. Heinz. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, June 25, 1933, pages 265-266. The author first discusses the difficulties generally encountered in casting large disks or covers of thin wall thickness in particular when the part is vaulted. It is shown how these difficulties were overcome in casting vaulted covers of 550 mm. in diameter, possessing a wall thickness of 3 mm. All covers cast according to the method described were smooth and free of defects. The advantages derived from casting such parts in green sand are pointed out. GN (12b)

Up-to-date Shaping of Cu Alloys by Die Casting Methods (Moderne spanlose Formung von Kupferlegierungen auf dem Wege des Spritzgussverfahrens) *Die Metallbörse,* Vol. 22, June 11, 1932, pages 737-738. The difficulties encountered in the development of die casting Cu alloys in comparison with Al and Zn alloys are reviewed. The 2 standard German machine types are characterized with particular emphasis on the mold. The following data are given, revealing the favorable properties of brass die casting alloys.

Material	Tensile Strength kg./mm.²	% Elongation	Brinell Hardness
Zn-Pb die casting alloy	8	2	24
Zn " " "	18	1	35
Al " " "	14	2.5	70
red brass 5	60	9	50
brass sand casting alloy Ms63	20	10	55
" die " " Ms58	38	5-15	100-133
press brass Ms58	40	20	100

Die casting temperature : 825-850°C. Fittings from 20 g.-5 kg. with wall thickness between 1-10 mm. can be made. Valves of die cast brass burst at 500 and 790 atm. respectively. Pipe joints lined with Cu at the inside and provided with a die cast brass shell furnish corrosion resistant joints for the chemical industry. Recently Cu alloys with 15% Sn and Cu, and brass high in Ni were successfully employed as die casting alloys at 925°-950°C. EF (12b)

Casting of Metal around an Iron Shaft (Ueber das Umgiessen einer Eisenwelle mit Metall) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Aug. 6, 1933, pages 327-328. Various points to be observed in casting, for instance, a porefree socket around an iron shaft are discussed. Casting in green sand in order to attain uniform cooling velocity. Type and condition of the molding sand are of prime importance. Mold must be rammed tight. As to gating and molding of the shaft in either vertical or horizontal position no definite rules can be given. Both methods of casting are considered, both giving porefree castings. Special precautions are required before casting. Shaft must be heated to 150°-180°C. before casting. To avoid condensation of H_2O the shaft mold and shaft are to be insulated by resin or a mixture of graphite and alcohol or graphite and petroleum. Metal must be cast hot and casting not be removed from flask too soon after casting. GN (12b)

On the Life of Ingot Molds (Hallbarheten hos Stalverkskokiller) Torkel Berglund & Arvid Johannson. *Jernkontorets Annaler,* Vol. 117, May 1933, pages 211-243. Investigations on the life of ingot molds in several Swedish steel plants resulted in the following conclusions: The graphite should be neither coarse nor fine. The most favorable Si and Mn contents for cupola furnaces were 1.3-1.6% and 0.7-1.0% respectively. In soft steel molds a P content of 0.2% may be tolerated, and a S content of 0.1%. Green and dry sand gave the same results. Annealing does not increase life of molds. Electric furnace molds with scrap from old molds were less uniform than cupola furnace molds. Some Bessemer pig molds had unusually long life. Decomposition of cementite into Fe and temper carbon caused an expansion which cracked interior surface of mold. 6 references. HCD (12b)

Dirigold (Dirigold) Robert J. Snelling. *Deutsche Goldschmiedezeitung,* Vol. 36, Aug. 12, 1933, pages 344-346. Dirigold are Al bronzes of variable Al content used for art castings. For this purpose pure binary Cu-Al bronzes are best. The detrimental effect of impurities is considered. The desired color of these bronzes is chiefly attained by the Al content but also by a certain treatment with acids as described in detail. In following the rules given the various colors can be obtained as desired provided contaminations by other metals are avoided. Of great importance are alloying and casting procedure. Before casting into the article in question alloy should be cast in small ingots at least twice. Alloy must be melted under salt cover, carefully cleaned before casting and cast at the lowest possible temperature so the metal will properly fill the mold. Author states that with due consideration of all precautions discussed art castings are obtained that compare with the English metals used for art castings. GN (12b)

Continuous Casting of Steel Sections to Reduce Rolling. B. Sheynin. *Metallurgia,* Vol. 8, July 1933, page 76. Suggests casting a continuous billet, say 3 x 3 in., by moving mold at rate metal solidifies. Seems to be a suggestion and not a method that has been tried. JLG (12b)

Mathematical Treatment of Solidification Phenomena Occurring During the Casting of Metals (Zur rechnerischen Behandlung der Erstarrungsvorgänge beim Giessen von Metallen) C. Schwarz. *Zeitschrift für angewandte Mathematik und Mechanik,* Vol. 13, June 1933, pages 202-223. The results of Saito, Lightfoot and A. L. Feild are reviewed. The writer states that the effect of the varying conductivity of the mold and the resistance which the incomplete contact between ingot and mold offers to the heat exchange immediately after casting has not been taken into account adequately. The mathematical derivation of some 95 formulae pay due consideration to the latter occurrences thus approaching conditions actually prevailing in steel foundries. The temperature distribution in a cylindrical steel ingot and a cast Fe mold is graphically presented. A mean gap width of 2 mm. between mold and ingot and a mean slit temperature of 800°C. are assumed. The scheme set forth may be intelligently applied to metals of other shrinkage properties and to different ingot dimensions resulting in differently sized gaps between casting and mold. WH (12b)

Precision Casting Utilizing the Hygroscopic Action of Plaster in Investment in Making Expanded Molds. C. H. Scheu. *Journal American Dental Association,* Vol. 20, July, 1933, pages 1205-1215. Scheu describes a technique which involves investing the wax pattern in plaster, permitting the plaster to set for a definite length of time, placing the invested pattern in water at 100°F. for 20 to 30 min. to expand the investment, burning out the wax, and casting at a mold temperature of 600° to 800°F. The expansion of the mold in water depends upon composition of investment, time from mixing to immersing, ratio of investment to water, time of mixing, etc., but Scheu has worked out tables which provide for different amounts of expansion to compensate for the different shrinkages in casting golds. OEH (12b)

Shop Method for Determining Volume Changes in Cast Iron During Casting. E. J. Ash & C. M. Saeger, Jr. *Foundry Trade Journal,* Vol. 47, Sept. 8, 1932, pages 140-141. Paper presented to the Detroit meeting of the American Foundrymen's Association. See *Metals & Alloys,* Vol. 4, Sept. 1933, page MA 295. OWE (12b)

Die-Casting (Ueber Spritzguss) Roessler. *Die Giesserei,* Vol. 19, Nov. 25, 1932, pages 483-484. Methods and conditions for obtaining a good product are discussed; of principal importance are: 1. a die-casting machine of such design that liquid metal can be put under high pressure; 2. a mold which will stand strain by metal flowing under high pressure and high temperature, and 3. an alloy which develops certain physical properties in finished casting by die-casting process. Economy of this method is particularly great for complicated parts; a number of examples illustrate this. Ha (12b)

Observations on Freezing of Ingots (Betrachtungen über das Erstarren von Metallblöcken) W. Roth. *Zeitschrift für Metallkunde,* Vol. 25, June 1933, pages 134-137. Formulas previously proposed for rates of cooling and temperature distribution in ingots are used to picture the temperature changes with time in various parts of an ingot, with proper consideration of the effect of the freezing process (or of transformation processes in the solid state). This is represented by three-dimensional diagrams showing temperature, time, and distance from ingot wall. Temperature measurements were made during the freezing of an ingot of brass (70:30) at 3 positions: the edge, midway between the edge and the center, and the center; the temperature-time curves are of the type predicted. RFM (12b)

Experiments on the Crystallisation of Ingots. R. G. Heggie. *Transactions Faraday Society,* Vol. 29, June 1933, pages 707-721. Work carried out at Sheffield University under supervision of C. H. Desch. Under simplest conditions of freezing, that is without introduction of motion due to teeming, columnar crystallization will persist to center of the ingot. A solid solution has a limiting cooling rate below which the equi-axial form of crystallization will take place throughout the ingot, and above which, under still conditions of freezing, only columnar crystallization will be obtained. This limiting critical cooling rate is a function of the width of the freezing range of temperature of the solid solution. In a pure substance, under still conditions of freezing, only columnar crystallization can be obtained owing to the fact that the width of the freezing range of temperature is 0. Motion has a definite effect on the change from columnar equi-axial crystallization, probably having its greatest effect when a state of dynamic heat balance has been set up. The time-thickness and other curves obtained on stearic acid confirm those obtained by Matuschka on steel, and support the assumption of a range of dynamic heat balance. The temperature gradient curves obtained resemble those calculated by Saito and Lightfoot, and show definitely that for stearic acid, a state of dynamic balance does exist. Under-cooling does not necessarily produce equi-axial crystallization in an ingot of stearic acid, nor does it appear to change the columnar form of crystallization under normal conditions. WAT (12b)

Ingots Cast by New Method. L. Gerald Firth. *Iron Age,* Vol. 131, Feb. 2, 1933, page 197, adv. sec. page 20. Describes new method of ingot casting developed by Firth-Sterling Steel Co., McKeesport, Pa. The process consists in casting in a cloverleaf-shaped mold, in cutting off the three wings, and discarding the central portion. Ingots weighing from 1000 to 10,000 lbs. have been cast with good results. VSP (12b)

Rolling (12c)

Automatic Sheet Catchers Impose New Demands on Motors and Control. W. B. Snyder. *Steel,* Vol. 91, Oct. 31, 1932, pages 21-23. The electrical equipment and operation of automatic catcher installations for 2-high finishing mills are described. JN (12c)

Cause of Roll Breakage in Tinplate and Sheet Mills. John Williams. *Blast Furnace & Steel Plant,* Vol. 20, Dec. 1932, page 907; Vol. 21, Jan. 1933, page 66. Roll breakage is attributable to simultaneous operation of several factors. Chief reason is unequal expansion and contraction of the different parts of the roll due to unequal temperatures. Contributory causes are excessively high or irregular chill and indifferent dressing or overstrain. Working sizes in rolls too wide for the purpose causes breakage, as this accentuates detrimental effects of uneven temperatures. Rolls usually break diagonally when abnormal strain is the deciding factor. MS (12c)

Bearings for Rolling Mill Gear Drives. F. Waldorf. *Blast Furnace & Steel Plant,* Vol. 21, Apr. 1933, pages 201-206, 219. Discusses method of calculating bearing loads, selection, mounting, and lubrication of bearings, and interaction of motor and fly-wheel during rolling as determined by Puppe in 1910. MS (12c)

Theoretical Determination of the Optimum Power of Rolling Mill Motor of the First Sovietistic Blooming Mill. A. P. Vinogradov & D. I. Starchenko. *Domez,* No. 12, 1932, pages 31-47 (In Russian). Using method of rolling coefficients of A. I. Time and A. P. Vinogradov the work consumed for deformation of one ingot is determined and distributed over the passes proportionally to the work of deformation of each pass. An assumption is made that the work of friction of the metals between the rolls and additional work of friction are proportional to the energy of deformation. The method is particularly valuable for rating of the motor on the basis of the energy consumed in different passes. Detailed mathematical treatment is given. (12c)

Influence of the Roll Dimensions on the Economy of Shape Rolling Mills (Der Einfluss der Walzenabmessungen auf die Wirtschaftlichkeit der Profileisenwalzwerke) W. Gernhard. *Die Metallbörse,* Vol. 22, July 23, 1932, pages 929-930; Aug. 1932, pages 1005-1006. The manufacture of medium sized profile irons on smaller rolling mills than usually applied is more economical. The conditions prevailing in an 850 mm. diameter and 2300 mm. roll length rolling mill are critically compared with a mill having rolls of 650 mm. diameter and 1800 mm. length. The specific wear of heavier rolls is larger than that of smaller ones, since the graphite segregation becomes more pronounced towards the core with increasing dimensions. The low power consumption of the smaller rolls is stressed. Detailed calculations show that friction losses of the bearings when running idle are 20% lower with the 650 mm. mill. The bearing friction losses during rolling includes work for covering the friction during idling and the additional friction work due to the rolling pressure. The latter is computed to be 16% lower with the 650 mm. mill. Power consumption of the 850 mm. mill is about 10-15% larger than that of the 650 mm. mill when rolling medium sized shapes. EF (12c)

Bearings of Novotext (Lagerschalen aus Novotext) *Maschinenbau,* Vol. 12, Jan. 5, 1933, page 23. Novotext, a pressed material, is generally employed for gears, etc., in machine construction. It is also recommended for bearings in rolling mills. It suffers much less wear than wooden or metal bearings commonly in use for this purpose. RV (12c)

Simple Pass Design Methods for Rolling Non-ferrous Metals (Vereinfachte Kalibrierungsverfahren für das Auswalzen von Nichteisenmetallen) O. Emicke. *Zeitschrift für Metallkunde,* Vol. 25, June 1933, pages 127-132. A discussion of new graphical methods. Includes discussion. RFM (12c)

Micarta Roll Neck Bearings. W. E. Brindley. *Blast Furnace & Steel Plant,* Vol. 20, Oct. 1932, pages 778-780. Discusses properties and applications of Micarta bearings. Micarta consists of sheets of paper or woven fabric treated with an organic binder and molded together at 150°-180° C. at pressures of 1000 lb./in.² or more. It has high strength, light weight, relative toughness, low moisture absorption, and resistance to corrosion. During past few years use of Micarta for roll-neck bearings has increased. It has been found that these bearings may be applied to stands where pressures do not exceed 2500 lb./in.² and shaft speed is over 100 ft./min. Coefficient of friction decreases with speed. Results from operating mills indicate that an average of 20-30% power saving may be expected. Life of this type of bearing varies considerably depending on mill conditions. Increases of 3-10 times the life of common metallic bearings have been obtained. MS (12c)

Innovations in Guides for Rolling Mills (Neuerungen an Führungskasten für Walzwerke) H. Cramer. *Stahl und Eisen,* Vol. 53, Mar. 9, 1933, pages 241-243. Various designs for attached and unattached guides are illustrated and their advantages explained. SE (12c)

Rolling Stainless Steel Plate. L. M. Curtiss. *Metal Progress,* Vol. 24, Aug. 1933, pages 27-30. Much care must be exercised in producing heavy plate of high cost material of this type. Direct rolling from ingot is not possible, shape of slab must be such as to give a nearly rectangular plate, deep chipping must be avoided. Best size and shapes of slabs are given. Rolling and preliminary descaling operation are discussed. Finishing operations of annealing, sandblasting or pickling, and straightening are described. WLC (12c)

Gripping of the Rolls. (Ueber das Greifen der Walzen.) E. Dann. *Archiv für das Eisenhüttenwesen,* Vol. 6, June 1933, pages 539-541. Equations are derived for the frictional forces in rolling, the force required to pull the work through the rolls, and for the relation between the average and maximum compressive force. SE (12c)

Straightening Rolls for Structural-Steel Shapes. *Engineering Progress,* Vol. 13, Aug. 1932, pages 183-186. A machine resembling a rolling-mill has been designed particularly for the straightening of rails and other extra heavy shapes. The straightening roll system comprises: 3 driven top rolls, 2 lower vertically adjustable idling rolls, one adjustable entry roll, and 1 extra roll carried in a separate frame, which permits of horizontal and vertical adjustment. Describes construction, care, and operation. RHP (12c)

Sheet Mill Features Built-in Equipment for Measuring Pressures on Rolls. *Steel,* Vol. 91, Aug. 22, 1932, page 28. Two telemeter units have been permanently installed, one on each side, in a new 4-high sheet mill to record roll pressures during operation. JN (12c)

Cold Rolling Strips by the Steckel Process. *Iron Age,* Vol. 129, Jan. 14, 1932, pages 168-171, 214. Describes process developed by A. P. Steckel, equipment used in carrying on the process and service in which it has thus far been applied. Primary object of process is to preserve ductility in the strip. Advantages claimed are that the metal is flat and has no center crown, no surface decarbonization, freedom from process pickle embrittlement, absence of edge cracking, hardness without loss of all ductility, higher and better physical properties, lower annealing cost and extreme accuracy of gage throughout length of strip. Arrangement of Steckel mill used by Cold Metal Process Co. is explained. VSP (12c)

Density of Zinc in Dependence upon Deformation by Cold and Hot Rolling. (Die Dichte von Zink in Abhängigkeit von der Verformung durch Kalt- und Warmwalzen.) O. Bauer & P. Zunker. *Zeitschrift für Metallkunde,* Vol. 25, July 1933, pages 149-153. Literature on effect of deformation on density of metals and alloys is reviewed. Electrolytic and retort Zn were studied, the first containing 0.015% Pb, 0.003% Fe, 0.005% Cu, 0.0008% Cd, and the second approximately 1.20% Pb, 0.02% Fe, 0.002% Cu, 0.11% Cd, 0.001% Sn, 0.001% Sb. The samples were cast and rolled in small increments (0.2 mm. in 10 mm. thickness), at room temperature and after heating to 175° C. The density values in dependence upon decrease in thickness are given in tables and graphs. The density of electrolytic Zn rolled to 1 mm. thickness was found to be 7.133; when rolled to less than 1 mm. the density decreased to 7.121. The retort Zn has a higher density (because of the Pb-content) but also shows a decrease in density in rolling to less than 1 mm. thickness. RFM (12c)

Influence of Hot Rolling and Forging upon the Structure of Steel Alloys. W. J. Merten. *Heat Treating & Forging,* Vol. 18, Sept. 1932, pages 525-528. Discusses cold shortness of steel, influence of hot working on structure, and thermal treatment to obtain maximum refinement of grain structure. MS (12c-d)

Forging (12d)

Flow Lines in Forged Steel. Eugene W. Nelson. *Heat Treating & Forging,* Vol. 18, Aug. 1932, pages 465-467; Sept. 1932, pages 529-530, 534. Discusses formation of flow lines in forgings from casting of ingot to finishing of piece and describes procedure for their examination. Illustrates importance of careful control of flow lines in manufacture of bolts, wrist-pins, crank-shafts, gears, and connecting-rods. MS (12d)

Progressive Improvements Made in Technique of Bolt Manufacture. J. B. Nealey. *Steel,* Vol. 91, Nov. 28, 1932, pages 23-26. Detailed description of automatic and semi-automatic hot forging methods for production of nuts and bolts. JN (12d)

Close Limits on Machine Forging Work. S. A. McDonald. *Mechanical World & Engineering Record,* Vol. 93, June 23, 1933, pages 559-561. It is possible to eliminate turning or milling operations before grinding by the fine forging tolerances with the latest types of forging machines. Hot forgings are passed directly from a forging machine to a sizing machine without reheating. The second operation takes place below scaling temperature, and results in a good finish. Kz (12d)

Machining (12g)

Turning and Drilling Stainless Steel. H. Bentley. *Mechanical World & Engineering Record,* Vol. 92, Nov. 4, 1932, page 442. To avoid work-hardening, feeds and speeds for different kinds of cuts are given. Machining operations and particulars about the tools used are mentioned. Kz (12g)

Machining of Austenitic Chromium Nickel Stainless Steels (Usinage des aciers inoxydables austénitiques au Nickel Chrome) A. Babinet. *Revue du Nickel,* Vol. 3, July 1932, pages 114-116. A description of the methods best suited for machining austenitic stainless steels. AH (12g)

The Elements of Milling. O. W. Boston & Chas. E. Kraus. *Transactions American Society of Mechanical Engineers,* Vol. 54, Oct. 15, 1932, *Research Papers Section,* pages 71-104. Milling energy data were experimentally determined and a mathematical expression determined. The tests showed that lubrication rather than cooling has greater effect. Milling up and down with the cutter shows a difference. The fine-tooth cutter cutting down produces the greatest average thickness of chip in all combinations of materials, lubricants and cutters under test; it seems to be the most efficient way of milling when power is the chief consideration. (Ha (12g)

High Speed Machining. H. Bentley. *Metal Industry,* London, Vol. 41, Nov. 4, 1932, page 440. Tungsten-carbide tipped cutting tools are used to the best advantage with cutting speeds of 500-800 ft./min. for rough turning Cu and soft brass, or up to 1000 ft./min. for finishing. For hard brasses Mn and P bronze cutting speeds should be 200-450, and 400-800 ft. respectively; for cupro-nickel, 350-500 ft., Al 500-1000 ft., and finishing up to 4000 ft. The top rake for these materials should be 8 to 13° for soft brass, 24 to 30° for Cu, 0 to 3° for hard brass and bronzes, 24° for Al and 15° for Al-alloys. Ha (12g)

Determining the Value of Tungsten Carbide Milling Cutters. B. P. Graves. *Machinery,* Vol. 38, May 1932, pages 650-653; June 1932, pages 761-763. Presents results of tests made by Brown & Sharpe Mfg. Co. to determine what changes would be necessary in machine tools to make them suitable for application of W-carbide. Gives mathematic calculations and several tables of speeds, feeds, chip, cut depth and length, cutting time. Discusses power requirements, life and uses. RHP (12g)

Suitability Only Safe Criterion in Selecting Cutting Fluids. Joseph Geschelin. *Automotive Industries,* Vol. 68, May 27, 1933, pages 638-640, 643. In the present state of the art a cutting fluid is thought to have 4 basic functions which in varying degrees are: refrigeration or cooling, oiliness, fluidity or penetration, and an anti-weld characteristic. Control of quality of finish, vehicle for washing away chips, and rust prevention aid are secondary functions. The final selection of a cutting fluid will be governed by the following factors: increased productivity, longer tool life between grinds, stability of mixture, better surface quality, and relative cost. Fixed specifications for cutting fluids appear to be an obstacle to production economies. Suitability appears to be the only safe criterion in their selection. DTR (12g)

Quality of Metal Surfaces. John Gaillard. *Industrial Standardization,* Vol. 4, Feb. 1933, pages 31-36. Graphical records of surface unevenness provide an accurate method of analyzing finish produced by various tools. Methods for making such records are reviewed and illustrated. AHE (12g)

Increasing Efficiency of Old Machine Tools by Modern Devices. (Förderung der Wirtschaftlichkeit älterer Werkzeugmaschinen durch neuzeitliche Werkzeugeinrichtungen.) Otto Lich. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, Mar. 26, 1933, pages 185-186. Illustrated description of a large number of modern devices of various German makes to increase the efficiency of machine tools. GN (12g)

Modified Machine Line for Heavy Twelves and Sixteens. R. F. Russell. *American Machinist,* Vol. 76, Mar. 31, 1932, pages 417-421. Illustrates and describes equipment and methods used in the production of 12 and 16 cylinder equipment by the American LaFrance & Foamite Corporation. Deals with machine operations rather than materials. RHP (12g)

Speeds and Feeds for High-Speed Steel Milling Cutters. A. J. Snyder. *Machinery,* Vol. 38, Aug. 1932, page 912. Gives milling speeds for several types of steels, bronze, brass, and Al. RHP (12g)

Speeds and Feeds for Carbon and High-Speed Steel Drills. A. J. Snyder. *Machinery,* Vol. 38, July 1932, page 816. Three tables present data for Al, brass, cast iron, mild steel, malleable iron, steel, Ni steel, tool steel, drop-forging, Mo steel, stainless steel and Monel metal, and slate. RHP (12g)

Large Combined Planing and Milling Machine. (Grosse vereinigte Hobel- und Fräsmaschine.) F. Sipmann & A. Schlegelmilch. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Apr. 22, 1933, pages 423-424. In order to utilize large planing machines better and to make them more flexible a combination of such a machine with a milling machine is described in detail for pieces of 10 m. (32.8 ft.) greatest length, 4.2 m. (13.7 ft.) width, 5 m. (16.4 ft.) height, and a total weight 100 tons. The machine itself has a weight of about 350 tons. Ha (12g)

Working of Aluminum and Its Alloys. (Die spanabhebende Bearbeitung des Aluminiums und seiner Legierungen.) A. von Zeerleder. *Schweizerische Technische Zeitschrift,* Vol. 30, Apr. 20, 1933, pages 225-230. The most suitable types of tools in working light metal alloys by turning, milling, cutting, drilling and filing are considered. On the basis of experimental results the effects of the cutting angle on the power consumption is especially referred to. GN (12g)

Tool Steel Economy. J. Winning. *Mechanical World & Engineering Record,* Vol. 92, Sept. 16, 1932, pages 261-262. The choice of a tool steel depends on (1) first cost, being approximately the same for all steels, (2) length of service which is affected by heat treatment, (3) cost of maintenance. The steel of tools in use is subjected to cold-working and a thorough annealing followed by hardening is required from time to time. Dealing with the maintenance of tools attention is paid to heat treatment, grinding and finishing. Kz (12g)

Life of Tools Machining Free-Cutting Brass. L. D. Spence & J. A. Hall. *Transactions of American Society of Mechanical Engineers,* Vol. 54, Oct. 15, 1932, *Machine Shop Practice Section,* pages 139-142; *Machinery,* Vol. 39, Sept. 1932, page 43. Data on life of tools for free-cutting brass in automatic screw machines were collected under shop conditions. Larger feeds and higher cutting speeds than those employed in normal practice can be used without impairing tool life. Maximum economy in machining free-cutting brass will be obtained by running stock with highest available spindle speed and using the greatest feed which work and tools will stand. Ha + RHP (12g)

Researches on the Cutting Force. VII. Cutting Force Acting on Twist Drill. Makoto Okoshi. *Bulletin Institute of Physical & Chemical Research, Tokyo,* Vol. 12, Mar. 1933, pages 295-328. Difficulties involved in the evaluation of the distribution of the cutting force on a drill head and consequent proper shaping of a twist drill are stressed. The experimenter measured the radial distribution of the vertical and horizontal components of the cutting force on the drill head and discusses the effects of drill diameter, chisel point, and twist angle on the distribution of the cutting force. Furthermore the points at which the resultants of the vertical and horizontal components act are determined and an explanation is given accounting for the rapid increase of the twisting moment at the instant when the drill head reaches the rear surface of the working material. WH (12g)

Pickling (12i)

Scale Removal by Acid Pickling. A. B. Winterbottom & J. P. Reed. *Sheet Metal Industries,* Vol. 6, Oct. 1932, pages 331-344; *Foundry Trade Journal,* Vol. 47, Oct. 6, 1932, pages 204-205; Oct. 13, 1932, pages 221-223; *Iron &*
1 *Coal Trades Review,* Vol. 125, Sept. 16, 1932, pages 417-421; discussion, Sept. 23, 1932, page 464; *Engineering,* Vol. 134, Dec. 2, 1932, pages 667-668. From paper before the Iron & Steel Institute, Sept. 1932. See *Metals & Alloys,* Vol. 4, June 1932, page MA 187. AWM + OWE + Ha + LFM (12i)

The Effect of Insufficient Pickling on Subsequent Galvanizing. V. A. Wardell. *Industrial Chemist,* Vol. 9, July 1933, pages 233-234. A short discussion of some of the difficulties encountered in pickling sheet iron. RAW (12i)

Scale Removal on Steel Parts by Pickling in H_2SO_4 and HCl Solutions. (Entsinterung von Stahlteilen durch Beizen in Schwefel- und Salpetersäurelösungen.) *Die Metallbörse,* Vol. 23, Dec. 17, 1932, pages 1613-1614. A literature review mainly based on investigations of Pfeil, Winterbottom, Edwards, Winterbottom & Reed. The summary recommends the following working conditions: (a) 50 g.
2 H_2SO_4 per 1000 cc. H_2O at 60°-80° C. bath temperature secured by steam coils. The concentration given above must be maintained. A pre-pickling bath should not contain less than 10 g. H_2SO_4/liter. (b) Fresh solution of 100 g. HCl/1000 cc. H_2O used at 30°-40° C. by addition of more hot solution or steam and later preserved by the reaction heat. EF (12i)

Cold Working (12j)

New Process for Cold Drawing of Metals. C. L. Mantell. *Iron Age,* Vol. 131, Jan. 12, 1933, page 99, adv. sec. page 12. Describes the Dud-
3 zeele process which permits a number of drawing operations without annealing and pickling following each draw. Pb coating on material to be cold worked acts as a lubricant and is said to reduce the number of annealings, picklings, etc. between draws. Gives some typical plant results. VSP (12j)

Materials for Cold Heading. Structure More Important than Composition. H. B. Pulsifer. *Metal Progress,* Vol. 23, Mar. 1933, pages 13-17. Properties of 9 materials for cold heading are discussed. Physical properties and relative cost are given in a table. Etched longitudinal section micrographs of each material are also presented. The chemical analysis is unimportant from a fabricator's viewpoint if physical properties are satisfactory. The structure is important as it determines the heading properties. The 5 steels are α ferrite and pearlite, ranging from large
4 grains of ferrite with patches of pearlite in the S.A.E. 1010, to S.A.E. 3135 where the relative volume of the 2 phases is reversed. The pearlite of the 2330 merges into spheroidized cementite, which is not injurious if the material has low enough Brinell. Materials with slag, sulphides or selenides are unsuitable for cold heading. Brass, Everdur, Duronze and Monel metal are the more costly materials discussed. Leaded brass or brass with beta constituent will shear in cold heading. Duronze has highest plasticity with greatest reduction. Everdur is next in this respect. Too much stiffening in wire drawing brass and Monel causes oblique shearing in cold heading. C and alloy steels for cold heading may have up to 0.65% C provided α ferrite is preserved in the structure and the material is not too hard. Physical defects, such as slag and pipes and excessive hardness cause trouble in upsetting.
5 Brinell range should be 116 to 196. Surface is important and a variety of coatings are used to preserve it. WLC (12j)

Bending, Stamping, Rolling. (Biegen, Prägen, Rollen.) Kress. *Maschinenkonstrukteur-Betriebstechnik,* Vol. 66, May 10, 1933, pages 90-92. Considers mentioned working processes of metals. Data are given on the elongations of the material at these working methods. GN (12j)

Polishing & Grinding (12l)

Technique of Size Control in Precision Grinding Operations. R. E. Harrison.
6 *Iron Age,* Vol. 130, Oct. 13, 1932, pages 570-571, Adv. sec. pages 16, 18, 20; *American Machinist,* Vol. 76, Oct. 12, 1932, pages 1065-1068. See "A Survey of Surface Quality Standards and Tolerance Costs Based on 1929-1930 Precision Grinding Practice," *Metals & Alloys,* Vol. 4, Apr. 1933, pages MA 124. VSP + Ha (12l)

Quest for Finer Finishes Turns Spotlight on Coolant Cleaning. Joseph Geschelin. *Automotive Industries,* Vol. 68, Mar. 25, 1933, pages 364-367. It appears to be the concensus of opinion that clean cutting fluid is absolutely essential in giving fine finishes. On certain types of machines and operations, especially in the case of abrasive tools, it is necessary to have a good filter along with the usual settling tank. The usual settling tank is inadequate wherever fine
7 metal or abrasive particles may scratch the surface. A positive economy is indicated with filters, due to increase in tool life, less frequent dressings of grinding wheels, less wear and tear on the pressure pumps and guide bushings. DTR (12l)

Cylindrical Lapping. F. B. Jacobs. *Modern Machine Shop,* Vol. 5, Feb. 1933, pages 14-18. Internal and external laps of Pb, brass or Cu and the methods of their use are described in detail. The speed should not be excessive as this does not result in fast lapping but wears out the lap rapidly. Generally, 0.0002" of material should be left for finish lapping, 0.0004"-0.0005" for lapping out wheel marks. Ha (12l)

Modern Grinding Machines for Switch Spindles. (Neuzeitliche Schaltwellenschleifmaschinen.) Rudolf Heymann. *Die Werkzeugmaschine,* Vol. 36, Dec. 15,
8 1932, pages 432-436, 442. Grinding of such spindles offers great difficulties due to complicated profile; various grinding methods are discussed. Various types of new grinding machines of the Fritz Werner Co., Berlin are described. GN (12l)

Fine Working of Metallic Surfaces. (Von der Feinstbearbeitung der Metalloberflächen.) Friedrich Huth. *Emailletechnische Monatsblätter,* Vol. 8, Oct. 1932, pages 75-76. Various polishing media for smoothly finishing metallic surfaces are discussed with special reference to SiO_2, CaO, Fe_2O_3 and Cr_2O_3, taking into consideration particularly physical properties. It is shown how and where they are to be used to best advantage. Lapping and press-polishing is briefly mentioned. GN (12l)

9 **Proper Grinding of Tungsten Carbide Tools. (Das richtige Schleifen der Wolframkarbid-Werkzeuge.)** Illies. *Das Werkzeug,* supplement to *Maschinenkonstrukteur-Betriebstechnik,* Vol. 8, Dec. 10, 1932, page 140. Brief discussion of important points to be observed in grinding such tools. Various tool angles for a large number of ferrous and non-ferrous materials are tabulated. GN (12l)

Designing for Economical Polishing. Rob. T. Kent. *Product Engineering,* Vol. 3, Dec. 1932, pages 474-477. Several examples illustrate how small parts should be designed so that they can be made of stampings and polished automatically instead of castings which usually require more expensive finishing by hand. Ha (12l)

10 **Reducing Grinding Costs.** E. E. Everett & W. E. Sanders. *Modern Machine Shop,* Vol. 5, Dec. 1932, pages 18-19. Very fast wear of supports for valves during grinding of latter was minimized by making them of "Nihard" cast Fe which contains about 3.5% C, 1.15% Si, 4.25% Ni and 1.5% Cr. Brinell hardness is between 580 and 650, according to composition and heat treatment. Ha (12l)

PLANTS & LABORATORIES (17)

Automatic and Continuous Skelp Mill made Possible with Gas. *Heat Treating & Forging*, Vol. 18, Nov. 1932, page 653. **Makes Conduit by Continuous Gas-Welding Process.** *Iron Age*, Vol. 129, Apr. 21, 1932, pages 920-922, adv. page 18. Brief description of Fretz-Moon Tube Co., Butler, Pa. See *Metals & Alloys*, Vol. 4, Mar. 1933, page MA 81. MS + VSP (17)

High Efficiency Iron Foundry. *Machinery*, London, Vol. 41, Dec. 29, 1932, pages 365-371; See also: **A New Mechanized Foundry.** *Mechanical World & Engineering Record*, Vol. 42, Dec. 23, 1932, pages 600-601. Description of mechanized plant of Ferranti, Ltd., Hollinwood, specializing in castings of non-magnetic iron. The article deals with the foundry layout, iron melting facilities, continuous molding plant showing an output of 1,500-1,800 finished molds in 8½ hours and the metal pouring and sand-handling equipment. Kz (17)

Magnetogorsk—The World's Largest Steel Plant. *Chemical Age*, London, Vol. 27, Dec. 3, 1932, Metallurgical Section page 34. Program under the 5 Year Plan in Russia for the development of Magnetogorsk, the heart of the iron ore region, and of Kusnetz in the coal region, calling for a steel plant to produce 2,500,000 tons of steel a year with an eventual capacity of 4,000,000 tons has now (Aug.) 2 blast furnaces and 2 coke ovens in operation. It is now expected to require until 1935 or 1936 to complete the program. VVK (17)

Construction of Magnitogorsk Steel Plant in Russia. (Vom Bau des Hüttenwerks Magnitogorsk in Russland.) *Technische Blätter der deutschen Bergwerkszeitung*, Vol. 23, Apr. 2, 1933, page 198. Description of plant with special reference to blast furnace plant and the blowers to supply the blast. GN (17)

Handle Sand and Molds On Conveyors. *Foundry*, Vol. 60, Dec. 1932, pages 12-14, 16. Claims compactness, flexibility, increased production and reduction in operating cost for a mechanically operated sand and mold handling unit installed in foundry of Westinghouse Elec. & Mfg. Co., Cleveland. Activities are grouped close to one of the cupolas and near cleaning room. Conveyor system is controlled automatically. VSP (17)

The Foundries of Craven Brothers (Manchester), Limited. *Foundry Trade Journal*, Vol. 47, Sept. 29, 1932, pages 184-187. Description, with a series of photographs. The organization provides high-grade castings for heavy engineering purposes. OWE (17)

Latest British Blast Furnace Design. *Iron & Steel of Canada*, Vol. 15, Nov. 1932, pages 140-142. Description, accompanied by 1 diagram, of the 400-600 ton blast furnace and accessory plant recently built at the Derwent works of the United Steel Companies, Ltd. OWE (17)

Wide Flange Beam Mill of South Chicago Works. *Iron Age*, Vol. 129, Mar. 3, 1932, pages 541-545. Describes addition of a 40,000 ton a month capacity beam mill and seven 150-ton stationary open-hearth furnaces by Illinois Steel Co. at Gary Works, and fourteen 150-ton stationary furnaces at the South Chicago works. VSP (17)

A Large Electrical Aluminum Plant (Eine elektrische Aluminium-Grossanlage). R. Gautschi. *Elektrowärme*, Vol. 2, Dec. 1932, pages 270-274. Typical arrangement of a large plant for electro-thermal treatment of Al is described; it usually comprises remelting, annealing, refining, alloying furnaces, special reference is made to manufacture of Al-foil. Calculation of required energy consumption is explained. Ha (17)

Cummins Diesel Produced by Automotive Methods. Joseph Geschelin. *Automotive Industries*, Vol. 68, Jan. 28, 1933, pages 102-105. Description of Cummins new automotive Diesel Plant at Columbus, Ind. The factory layout, selection of equipment, tooling and other details follow the best current practice. Manufacturing costs are comparable to those of gasoline engines of equivalent power and built in about the same quantities. This plant is equipped for a production of 10 to 25 units per day. Machine tools have been selected for this volume and are chiefly simple, rugged tools capable of easy adaptability to design changes. DTR (17)

Precision, Flexibility and Low Cost All Attained in Lycoming Motor Plant. Joseph Geschelin. *Automotive Industries*, Vol. 68, Mar. 11, 1933, pages 308-312. Description of Lycoming Motor Plant. Precision in maintenance of close tolerances, flexibility of equipment, and low manufacturing costs have all been achieved. Most striking examples of precision are found in their practice of using single-purpose instead of multi-purpose tool bits, and subdividing of operations over a battery of machines. DTR (17)

Rapid Evolution of Bar Mills Typified by McDonald Plant. T. H. Gerken. *Iron Age*, Vol. 130, Oct. 27, 1932, pages 644-647. Describes mill of Carnegie Steel Co. at McDonald, Ohio, probably most complete plant of its kind in existence. Features of plant are vertical rolls on 2 stands in a 10" continuous mill delivering 1000-lb. coils and cooling bed with an unusual kick-off operation for straight bars. The 11 units now built comprise parallel mills, terminating in common warehouse extending crosswise of the works. VSP (17)

Chrysler "Shoots the Works" in New Plymouth Plant. Joseph Geschelin. *Automotive Industries*, Vol. 68, Feb. 4, 1933, pages 138-142. Description of some of new machines and processes employed to build Chrysler products at New Plymouth Plant. Writer characterizes this plant as one of most modern automobile plants in world. An insight of efficiency of work may be seen from following: 132 holes drilled in cylinder block in 1 setting; 18 operations on distributor shaft hole performed in 48 seconds; cylinder finish-bored within 0.0005" of round, and not more than 0.0005" taper. DTR (17)

The New Ore and Coal Dock at Hamilton. Robert A. Gillies. *Iron & Steel of Canada*, Vol. 16, Feb. 1933, pages 20-22. This new dock at Hamilton, Ont., provides accommodation for vessels of 15,000 tons capacity and provides unloading facilities of 650 tons/hour. OWE (17)

Pipe Casting in German and American Plants. A. A. Bulgacov. *Domez*, No. 12, 1931, pages 15-43. (In Russian). Detailed description of equipment and practice of pipe casting shops of Donnersmarkhuette, Luitpoldhuette and Schalke plants. (17)

Coordinated Heat Conservation at Steelworks. *Iron & Coal Trades Review*, Vol. 125, July 15, 1932, pages 73-74, 86-88; *Fuel Economist*, Vol. 7, Aug. 1932, pages 451-461. A plan for heat conservation is outlined giving as an example the Normanby Park Works in Lincolnshire (England) where lean ores have to be exploited and, in order to be able to compete with continental products made by the basic Bessemer Process, extreme economies had to be exercised in the whole arrangement of the plant. Coke is used in specially large quantities for these ores and is therefore made in the plant in close proximity to the blast-furnaces, and coke-oven and blast-furnace gases, either together or separately utilized for all heat requirements in the making and rolling of steel from the pig iron. 2800 tons of coke are produced per week in 48 coke-ovens. The plant layout and its equipment is described in detail. DTR + Ha (17)

Ewart Works of Link-Belt Company. *Heat Treating & Forging*, Vol. 18, June 1932, pages 379-380. Describes pulverized coal installation in malleable foundry, Indianapolis. MS (17)

Whitman & Barnes, Inc. *Heat Treating & Forging*, Vol. 18, May 1932, pages 321-322. Describes heat treating plant located in Detroit. Firm manufactures cutting tools, both high-speed and C steels being used. Drills are hot twisted into shape from rolled profile or grooved stock. Heat treating division is equipped with a battery of furnaces, lead-pots, salt baths, etc., all controlled from a separate control room. Use a new type of gas-fired furnace consisting of 2 units, one for preheating and the other for high heat. They are box-like with rounded ends. Work is put into the heating chamber through the top. Preheat furnace is 4 times the size of the high-heat furnace. MS (17)

BIBLIOGRAPHIES (19)

Drill Steels for Mining Purposes. W. H. Hatfield. *Bulletin Institute of Mining & Metallurgy*, No. 343, Apr. 1933, 38 pages; No. 344, May 1933, 38 pages; No. 345, June 1933, page 29. Best composition for drill steel, metallurgy of bit sharpening and normalizing after attaching a lug are discussed. Curves are given showing diamond hardness nos. of various specimens after quenching and tempering at various temperatures and hardness of various steels at elevated temperatures. Abstracts of 52 related articles are appended. AHE (19)

MISCELLANEOUS (20)

Cast Iron Roads. *Engineer*, Vol. 154, Dec. 2, 1932, page 571. Brief description of a cast Fe road recently constructed near Nottingham, England, for trial and observation. LFM (20)

Cast Iron Repairs in China. *Engineer*, Vol. 155, Jan. 13, 1933, page 42. From an article by Frank A. Foster in the Nov. 1932, issue of the *Worcester Polytechnic Gazette*. Brief description of method used for repairing a cast Fe cooking pan by the use of melted cast Fe used as a solder. The Chinese workman, an itinerant tinker carrying his entire equipment with him, applies the melted cast Fe with his fingers which are protected by heavy woolen pads. LFM (20)

The International Foundry Trades Exhibition. *Foundry Trade Journal*, Vol. 48, Apr. 20, 1933, pages 267-280. Summary of exhibits in Agricultural Hall, Islington, London, England, covering pig-iron products, sand mixers, and driers, refractories, general foundry plant, melting plant, molding machines, and optical instruments used by metallurgists. OWE (20)

Safety in Foundries. (Centraal Verslag Arbeidsinspectie 1931. Veiligheidstechniek in Gieterijen.) *De Gieterij*, Vol. 6, Oct. 1932, pages 96, 97, 98. Refers to precautions against CO poisoning and protection against sand blowing apparatus. It also concerns the regulations against possible injuries by molten metals. MPW (20)

Develops New Methods of Decorating Rustless Steel. *Iron Age*, Vol. 130, July 28, 1932, page 138, adv. sec. page 14. United Metal Products Co., Canton, Ohio, developed method of decorating high Ni-Cr alloys without using the etching process. Advantages claimed are that it is much cheaper than etching and more effective. Describes application of the process. VSP (20)

Influence of the Roughness of Surface on the Transmission of Heat, when Heated Gas Flows across the Periphery of Heat Transmitting Tubes. Kotaro Uhira. *Journal Society of Mechanical Engineers*, Tokyo, Vol. 35, Aug. 1932, pages 801-814. Paper read before 2nd General Meeting, Society of Mechanical Engineers, April 6, 1932. Experiments proved that the formula for heat transmission differs according to the appearance of the surface of the tubes. Kz (20)

German Practice in Surface Designation. John Gaillard. *American Machinist*, Vol. 76, Apr. 7, 1932, pages 449-452. Discussion of German standards. Mechanical limits have been subject to precise specification for sometime. Recent study of surface specifications leads to this presentation of the German surface specifications. RHP (20)

Service Dictates Engine Design Changes. Joseph Geschelin. *Automotive Industries*, Vol. 68, June 3, 1933, pages 670-673. Modification in construction details and production methods are needed to permit use of less viscous oils demanded by diverse operating conditions. Summarizes and combines the varied work of a number of the leading investigators. DTR (20)

Methodical Distribution of the Orders in a Foundry. (Stelselmatige Werwerking van de Orders in een Gieterij). F. E. Eijken. *De Gieterij*, Vol. 6, Nov. 1932, pages 105-108. Author shows how he applied a method by which he was able to combine the work in a foundry to incorporate the emergency orders in the regular work. In order to do this he subdivides the capacity planning and the immediate planning. A complete example of the application of this method is given for a ferrous metal foundry including the types of cards used for records. MPW (20)

Theory and Statics of Plastic Steel Beams. (Theorie und Statik plastischer Träger des Stahlbaus.) K. Eisenmann. *Stahlbau*, Vol. 6, Feb. 17, 1933, pages 25-28. Materials, for instance steel, that become plastic at a certain strain offer a greater degree of safety in statically undetermined systems than in statically determined ones. Paper gives some fundamental investigations on calculation of such beams in which yield point is reached so that ranges of flow are formed. GN (20)

Standardization of Precious Metals. (Die Normung der Edelmetalle.) Christian Ernst. *Deutsche Goldschmiedezeitung*, Vol. 36, Mar. 25, 1933, pages 124-127. Detailed discussion of standards for Au, Ag and its alloys of the most important precious metal consuming countries. GN (20)

The B. A. Standards of Resistance, 1865-1932. R. T. Glazebrook & L. Hartshorn. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Vol. 14, Oct. 1932, pages 666-681. Summarizes achievements of Electrical Standards Committee of British Association. Discusses electrical resistance standards for Pt-Ir alloy, Au-Ag alloy, Pt, Pt-Ag alloy, and Hg. Records show that values of resistance of most of coils have changed during their long lives, but that the 2 original Pt coils have remained unchanged. RHP (20)

A Proposed British Foundry Technical Training College. Vincent C. Faulkner. *Foundry Trade Journal*, Vol. 47, Oct. 6, 1932, pages 199-200. An examination of the problem of the creation of centers for technical training of students for executive positions in the foundry industry in Great Britain. OWE (20)

Developments in the Electrical Industry During 1932. John Liston. *General Electric Review*, Vol. 36, Jan. 1933, pages 7-71. A comprehensive review of recent developments in the electrical industry. Topics of metallurgical interest include installations of electrically driven strip mills, automatic equipment for sheet rolling mills, application of control tubes and devices on rolling mill shear, introduction of new heavily coated electrodes for electric welding, newly designed automatic welding equipment, bright annealing furnaces of the bell-type heating chamber, continuous bright annealing furnaces, development of furnace atmosphere controllers and ammonia dissociator, molten bath heat treating furnace for Al alloys, new X-ray apparatus for industrial radiography. Many other new developments are discussed which although they are not directly concerned with metallurgy are important advances in related fields. CBJ (20)

How to make 50% Ferrosilicon which does not Disintegrate. (Comment on peut fabriquer du ferrosilicium à 50% ne tombant pas en poussière.) Ch. Louis. *Journal du Four Electrique*, Vol. 41, Nov. 1932, pages 415-416. Si-Fe alloys in the range of 45-65% Si, as well as those between 75 and 80%, disintegrated. This is always connected with a high C content, usually above 1%. The only case of disintegration is the presence of Al carbide in the metal. JDG (20)

Distribution of the Maximum Sliding Stress in a Roll Compressed between Two Parallel Plates by Load. (Die Verteilung der Maximum Schubspannung in einer Walze, die zwischen 2 parallelen Platten durch die Last zusammengedrückt wird.) Mutuo Kakuzen. *Journal Society of Mechanical Engineers*, Tokyo, Vol. 35, Aug. 1932, pages 772-785. Paper read before 2nd General Meeting, Society of Mechanical Engineers, April 7, 1932. Dealt with are (1) the stress at any point of the roll, (2) the max. sliding pressure. Kz (20)

Handbook of Technical Electrochemistry. Technical Electrolysis of Aqueous Solutions. (Handbuch der technischen Elektrochemie. Die technische Elektrolyse wässeriger Lösungen.) Vol. 2, Part 2. Edited by V. Engelhardt. Akademische Verlagsgesellschaft, Leipzig, 1933. Cloth, 6¾x9¾ inches, 328 pages. Price 32 RM. This section of the handbook deals with hypochlorite, chlorate, separation of halogens, oxidation and reduction of inorganic and organic compounds.

Of interest to the electrochemist engaged in the production of chemicals, this particular volume contains nothing of direct value to the metallurgist or electroplater. H. W. Gillett (20)-B-

FOUNDRY PRACTICE & APPLIANCES (22)

Molding Sands and Molding Materials. (Formsande und Formstoffe.) K. Schiel. No. 18 in H. Hermann's "Die Betriebspraxis der Eisen-Stahl- und Metallgiesserei." Wilhelm Knapp Verlag, Halle (Saale), 1933. Paper, 6¼ x 9¼ inches, 152 pages. Price 8.80 RM. Comprehensive discussion of the properties of molding and core sands and of methods for their determination, with many curves showing effect of grain size, moisture content, etc. on strength, permeability, etc. The apparatus used in sand testing in various countries is described and depicted. The discussion is quite complete and gives a very good idea of German methods of test. H. W. Gillett (22) -B-

A Revolutionary Method in Molding Practice. Louis Maillard. *Foundry Trade Journal*, Vol. 47, Sept. 8, 1932, pages 138-139; *Iron & Coal Trades Review*, Vol. 125, Oct. 14, 1932, pages 576, 577. **Cement for Molds (Zement für Gussformen)** *Technische Blätter der deutschen Bergwerkszeitung*, Vol. 22, Oct. 30, 1932, page 579. Abstract of paper before International Foundry Congress, Sept. 1932, Paris. See "Hydraulic Binders in the Foundry," *Metals & Alloys*, Vol. 4, Oct. 1933, page MA 330. OWE + GN + Ha (22)

Economics in Steel Casting Design. F. A. Lorenz, Jr. *Foundry*, Vol. 60, Oct. 1932, pages 20-22, 48, 50; *Steel*, Part I, Vol. 91, Dec. 12, 1932, pages 21-22, 24; Part II. Dec. 27, 1932, pages 19-21. See "Notes on the Design of Steel Castings," *Metals & Alloys*, Vol. 4, Oct. 1933, page MA 330. VSP + JN (22)

Preparation of Molding Sand (Die Formsandaufbereitung in zusammengesetzten Anlagen) A. Rodehueser. *Die Giesserei*, Vol. 19, Nov. 25, 1932, page 485. See *Metals & Alloys*, Vol. 4, Oct. 1933, page MA 329. Ha (22)

Making of High Test Cast Irons by Superheating and Refining in an Induction Furnace of Normal Frequency (La production des fontes de haute qualité par surchauffé et affinage au four à induction à fréquence normale) Albert Levasseur. *Revue Générale de l'Electricité*, Vol. 32, Sept. 24, 1932, pages 383-386. See *Metals & Alloys*, Vol. 4, June 1933, page MA 192. MAB (22)

Responsibility Factors in the Foundry (Facteurs de Responsabilité Agissant en Fonderie) J. Leonard. *La Fonderie Belge*, Vol. 2, July 1932, pages 116-119. Lecture before the "Association Technique de Sidérurgie de Charleroi" stresses that greatest development in foundry, since beginning of war, is found in a better knowledge of metals. High quality alloys have been developed. Today the founder must be a metallurgist in order to be able to continually follow the improvements brought every day by the modern industry and also to cooperate with users of castings. FR (22)

Core Drying in the Foundry by Recuperation of the Heat in Waste Gases (Séchage des Noyaux de Fonderie par la Récupération de la Chaleur emportée par les Gaz perdus) R. W. Meunier. *Revue Universelle des Mines*, Series 8, Vol. 9, May 15, 1933, pages 272-273. The necessity of reducing the sometimes considerable cost of drying cores is pointed out; increasing use of waste gases and reduction of labor and time for bringing cores to the drying chambers is essential. An installation taking these points into consideration is described where the waste gases of melting apparatus are used for heating the air for drying. The gases have a temperature of 550° C. and heat 18,000 m.^{3} of air/hr. to 270° C.; 80% of the air leaving the drying chamber is used again after mixing with fresh air. This method proved very economical. Ha (22)

Processing of Patterns and Mold of a Pressure Cylinder (Herstellung der Schablonen und der Form zu einem Druckzylinder) E. Merz. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 54, June 25, 1933, pages 269-270. Illustrated description of the procedure followed in making pattern and mold of a pressure cylinder. GN (22)

Electric Furnace Cast Iron in the Detroit Territory. N. J. Hall. *Electrical World*, Vol. 101, June 17, 1933, pages 796-797. Examples of electric furnace cast iron production are discussed. CBJ (22)

Manufacture of Cast Iron Water Pipes in America by McWane Method. A. A. Bulgakov. *Domez*, No. 2-3, 1933, pages 11-24. Detailed description of equipment and operating practice used at McWane Cast Iron Pipe Company plant near Birmingham, Ala. Pipes are satisfactorily cast in sand in horizontal position rapidly and cheaply. (22)

Production of a Stirring Vessel of Silumin (Herstellung eines Rührkessels aus Silumin) *Zeitschrift für die gesamte Giessereipraxis*, Vol. 54, Aug. 6, 1933, pages 331-332. Describes the molding of a stirring vessel as used in the chemical industry by sweep method. For this purpose a loam mold is more economical than a sand mold. Sweeps and pattern parts required are described and molding is considered at length. Metal is cast at 710° C. after having been treated with Na at about 710° C. GN (22)

Economic Production of Metal Patterns (Wie werden Metallmodelle wirtschaftlich gebaut?) *Zeitschrift für die gesamte Giessereipraxis*, Vol. 54, Aug. 6, 1933, pages 333-334. The most essential point to be borne in mind in processing metal patterns according to a given wooden pattern is proper consideration of shrinkage. Metal patterns close to dimensions are best obtained by subdividing the pattern. Method is considered at length for a small valve. Similarly the core box can be subdivided into individual parts. GN (22)

Non-Ferrous Foundries in Germany. Erich Weiss. *Metal Industry*, London, Vol. 42, June 30, 1933, pages 657-658. English and German non-ferrous foundries and foundry methods are discussed and compared with regard to use of scrap and virgin metal, and dry and green sand molds. Ha (22)

Decreasing Scrapped Castings by Faultless Cores with Special Reference to Quartz Sand Cores (Ausschussverminderung durch einwandfreie Kerne unter besonderer Berücksichtigung der Quarzsandkerne) Gustav Krebs. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 54, June 25, 1933, pages 262-264; July 7, 1933, pages 282-284; Aug. 6, 1933, pages 322-324; Aug. 20, 1933, pages 343-344. Experience shows that a considerable share of casting defects is due to inferior cores. Good material, proper treatment in making and drying are highly important. The first installment deals with requirements which good core sands have to meet, methods of testing the properties, suitable physical composition (mixture of various grain sizes) preparation of the sand batch. The second installment considers special core sands with special reference to oil sand cores, gives rules on suitable chemical compositions, proper choice of oils used, methods of mixing sand for oil cores. In the third installment are discussed the effect of core binders on strength and permeability to gases of cores, gas development upon casting, drying of cores and best drying temperatures for cores of various parts, drying ovens. The last installment is given to the applicability of oil sand cores to casting of various metals (steel, brass, Al and light metal alloys), facing materials, proper gating. In each installment the advantages of oil sand cores are clearly set forth. GN (22)

Defects in Casting Laboratory Fixtures (Ausschuss bei Laboratoriumsarmaturen) K. Lehmann. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 54, Aug. 20, 1933, pages 347-348. Discusses the difficulties frequently encountered in casting various types of laboratory fixtures. Proper gating, considered at length, plays a predominant role in avoiding defects. Proper making and treatment of cores is of similar importance. GN (22)

Pattern Production. E. Longden. *Mechanical World & Engineering Record*, Vol. 93, June 2, 1933, pages 527-529. Pattern work embraces all the devices necessary for making molds other than the molders' implements and materials. The choice of type of pattern depends upon costs and foundry methods to be used. Advantages are to be gained from pattern standardization and co-operation between departments. The practice of making patterns and molds is discussed. Ks (22)

The Position of Pattern Making in the Foundry Trade (Die Stellung des Modellbaus im Wirtschaftsleben) R. Löwer. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 54, Aug. 20, 1933, pages 353-354. Proper management of the foundry necessitates efficient organization in the pattern shop. GN (22)

Suggestions for Classifying Gray Iron Castings. W. Worley Kerlin. *Iron Age*, Vol. 131, Feb. 9, 1933, pages 234-235, 261. Classifies gray Fe castings into 7 groups. Discusses gray Fe castings listed as American Society for Testing Materials specification A48-32T, as to their tensile and transverse strengths. Shows importance of the classification to engineers and designers. VSP (22)

Efficiency of Vibrating Molding Machines in Cast Steel Foundries. Effect on Wages, Charges, Prices of Flasks and Cast Steel (Die Rentabilität von Rüttelformmaschinen in Stahlformgiessereien. Einwirkung auf Löhne, Unkostenzuschlag, Kasten und Stahlgusspreise) Walter Kerl. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 54, July 9, 1933, pages 278-281. The efficiencies of a large vibrating molding machine and of 3 smaller types with flask contents of 47 cdm., 108 cdm., and 190 cdm. were calculated. The working times per piece are compared with those attained by manual molding. Higher efficiency is attained by the smaller types of machines so that such machines should be used whenever possible. GN (22)

Surface Decarburization of Malleable Iron. John H. Hruska. *Iron Age*, Vol. 130, Sept. 22, 1932, pages 460-462. Gives results of investigations conducted by the author to obtain an unbiased opinion as to the homogeneity of malleable castings made by the black heart process. The problem was divided into: Chemistry of decarburization; influence of decarburization upon physical properties; hardness and microscopic investigations; and manufacturing technique. Tests show that malleable castings may be produced in accordance with the most rigid expectations pertaining to the uniformity of the interior and the intermediate surface layers of the castings. VSP (22)

Recover Dust in Sand Spun Plant. S. D. Moxley. *Foundry*, Vol. 60, July 1932, pages 26-27. In manufacture of cast Fe pipes by centrifugal sand spun method one of the most important features is the selection, separation and control of sand for refractory mold. Describes method and appliances used by the American Cast Iron Pipe Company. VSP (22)

Recent Research in the Iron Foundry. S. E. Dawson. *Foundry Trade Journal*, Vol. 48, Mar. 30, 1933, pages 225-228. Recent work is summarized under the headings of composition, sand, melting plant, rotary furnace, microstructure and C control, fluidity test, cooling effect, growth and heat-resistant iron. OWE (22)

High Alloy Castings, Their Foundry Problems. R. D. Alger & G. C. McCormick. *Metal Progress*, Vol. 24, July 1933, pages 15-19. The casting of the lower Cr-Ni alloys with Fe may be approached by the high alloy foundryman with the problem of eliminating expensive high class foundry work, and the steel founder with the problem of improving his practice to produce good castings. Special design is necessary for this class of work because of narrow pouring range and high volumnar and linear contraction. Change of section and self-distorting sections such as channels must be avoided. Chilling is difficult because of the interference of design, limitation in size usable, rough surface against the chill, and difference in cooling rates between chilled and unchilled areas. Uniform thickness between ⅛ and 1 in. should be used in the designs. Thinner sections can be used by high alloy technique on this work. Location of risers and gates are important because of the destructive action of these alloys on the molding sand. Cleanliness is important and skimming gates must be of special type. Dry molding sand is used for corrosion resistant and high polish parts. Natural and synthetic bonded sands are employed. Core sands are usually of a friable nature when hot because of high contraction of these alloys. Melting at the necessary high temperatures brings danger of excessive gas absorption during superheating, possibility of contamination from furnace lining erosion, and contamination from cutting action on the molding sand. Analysis alone is not a guarantee of good metal. Source of charging materials and melting practice must be controlled for uniformity and cleanliness in the castings. WLC (22)

The Production of Scotch Tubes (Die Herstellung von schottischen Rohren) A. Freitag. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 54, June 4, 1933, pages 216-221. Detailed discussion of production with special reference to molding practice generally used, making of the cores, preparation of the molding sand and other points to be observed. The author finally considers the casting practice and deals with the causes of the defects. The principal reasons of defects are: (1) too low casting temperature, (2) too slow pouring, (3) the walls of mold and core are rammed too loose, (4) core and mold sand are too wet or the walls are too solid, (5) poor adjustment of the cores, (6) improper setting of the mold, (7) too late or too early loosening of the core spindle after casting. Capacities of molding, melting charges, cleaning are dealt with. GN (22)

Molding Sand in the Foundry (Der Formsand in der Giesserei) E. Feil. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 54, Apr. 16, 1933, pages 156-158; Apr. 30, 1933, pages 176-178; May 14, 1933, pages 198-200; June 11, 1933, pages 241-243. After discussing properties which a good molding sand has to possess, author considers at length: (1) chemical investigation and (2) physical testing methods. Among latter methods determinations on permeability to gases and strength are particularly dealt with. The American types of apparatus used for the determination of gas permeability and binding strength are then described. The temperature stability of molding sands is suitably determined by means of the Seger cone method. The attaining of smooth castings is dependent on the grain size of the sand. The 3 methods generally used to determine this property are described: (1) dry or wet sieving, (2) the counting method and (3) the decanting method. The testing of sands of unknown origin should determine both the suitability as molding sand and the type of casting and cast Fe to which it can be applied most advantageously. Author then considers circulation of virgin sand in foundry and shows how this sand is tested according to the above mentioned methods. GN (22)

Prevent Losses With Proper Gates and Risers. Pat Dwyer. *Foundry*, Vol. 60, July 1932, pages 37-38, 40. Thirty-first of a series of articles. Porosity may be traced to a drainage of eutectic portion of metal downward after crystallization. Usually the position of pattern or mold is changed to prevent migration of elements in the metal, from one location to another in the casting. Presents gating methods used on a bronze hydraulic cylinder 21 in. inside diam., 10 ft. long, thickness of wall ⅝ in. and weighing 2000 lbs. Stick brass presents some features, both in making the mold and melting the metal. Adequate feeders are used to compensate for loss of volume in shrinkage. VSP (22)

Application of Acid Electric Furnaces in Steel Foundries (Anwendung der sauren elektrischen Öfen in der Stahlgiesserei) *Die Metallbörse*, Vol. 23, Feb. 4, 1933, page 147. During the last 2-3 years an increasing utilization of acid linings in arc furnaces is noticeable. If steel scrap with reasonably low P contents is available the following advantages are claimed: simpler metallurgical manipulation, longer life of linings, cheaper lining material, cheaper slags (1 shovel of $CaCO_3$/ton charge) better physical properties in case of Ni-Cr, V, Ni-Cr-Mo steels. EF (22)

Prevent Losses With Proper Gates and Risers. Pat Dwyer. *Foundry*, Vol. 60, Oct. 1932, pages 38, 40, 42. Thirty-fourth installment. Shrinkage of castings may be prevented by pouring metal slowly through small gate at bottom of high sprue, according to several investigators. According to a prominent west coast foundryman, who introduced a system of pressure casting in his foundry, this method eliminates shrinkage, heads and risers, shrinkage defects and porosity. It produces a denser casting and reduces cleaning room costs. The system is particularly applicable to production of valve bodies, bushings, gears, pump bodies, runners, and many other castings in which dense, homogeneous metal is of importance. VSP (22)

FURNACES & FUELS (23)

The Spatial and Temporal Progress of Combustion in Technical Firing (Die Raumliche und zeitliche Entwicklung der Verbrennung in Technischen Feuerungen) K. RUMMEL & H. SCHWIEDESSEN. *Archiv für das Eisenhüttenwesen,* Vol. 6, June 1933, pages 543-549. Judging the course of combustion by the rise in temperature, rate, and analyses at 1 point, is insufficient. A qualitative determination is possible only by gaging the combustion at several points and drawing curves for like degrees of combustion. It is shown mathematically that quantitative data can be obtained only when the equation for the degree of combustion over a surface is related to the degree of combustion in a reaction chamber. Data also could be obtained on the rate at which combustion became practically complete and on the time and direction of combustion. Practical examples are given. SE (23) 1

Combustible Losses in Flue Gases. J. D. KELLER. *Blast Furnace & Steel Plant,* Vol. 20, Sept. 1932, pages 723-726; Oct. 1932, pages 781-783, 786; *Heat Treating & Forging,* Vol. 18, Sept. 1932, pages 543-546; Oct. 1932, pages 595-598. Tests made with air ratios ranging from a slight deficiency to about 15% excess air, showed no hydrocarbons in flue gases, but H_2 equal to or slightly exceeding CO. Improved Ostwald charts are given and discussed for bituminous coal, fuel oil, and natural, coke-oven, city, and producer gases, constructed on the basis of equal percentages of H_2 and CO. MS (23) 2

Industrial Instruments for Plant Control. *Chemical Age,* Vol. 27, Nov. 12, 1932, pages 452-455. Description of electrically operated instruments for indicating and recording fluid flow, temperature, draft and percentage of CO_2 in flue gases produced by the Electroflo Meters Co. Ltd. of London. VVK (23)

Determination of Convective Heat Transfer along Narrow Masonry Gas Mains (Versuche zur Ermittlung der Konvektiven Wärmeübergangszahlen an gemauerten engen Kanälen) H. H. BÖHM. *Archiv für das Eisenhüttenwesen,* Vol. 6, Apr. 1933, pages 423-431. Gas heated to about 800° C. was passed through smooth, jagged, and rounded masonry channels and the temperature of the gas and brick along the channels measured. The effects on heat transfer of temperature, channel length, rate of gas flow, gas-brick temperature gradient, kind of gas and roughness of surface of the brick were determined and the results expressed in curves and equations for smooth and turbulent gas flow. SE (23) 3

Right Relations of Air and Oil in Oil Burning. ROBERT C. HOPKINS. *Iron Age,* Vol. 130, Sept. 8, 1932, pages 368-369, 397. Burner efficiency is determined by analyzing products of combustion, drawing gas from different parts of furnace, and checking results with an Oswald chart (here reproduced). Recuperation will show a fuel saving of from 15 to 50%, depending on condition of furnaces and equipment. VSP (23) 4

Study of Burners for Heavy Oil and Their Application in Metallurgy (Étude des Bruleurs d'Huile Lourde en Vue de leur Application en Métallurgie) CH. DENNERY. *Bulletin de L'Association Technique de Fonderie,* Vol. 7, Apr. 1933, pages 127-136. Detailed study of automatic heavy oil burners. Since heavy oils do not ignite at ordinary temperatures, it is necessary to add some auxiliary material either to the oil or to the air to lower the ignition temperature. Calculations for burners, oil and air pressures and volumes, and furnaces are given. WHS (23)

Determining Size and Personnel for Oil-Burning Furnaces. ROBERT C. HOPKINS. *Iron Age,* Vol. 130, Sept. 22, 1932, pages 456-458. Chart for calculating the capacity of a furnace is given. Automatic control saves money and at the same time improves the product. Flow meters in by-passes are of advantage at various points of the system. General. VSP (23) 5

Coal for Industrial Furnaces (Kohle für industrielle Feuerungen) W. SCHULTES. *Die Wärme,* Vol. 56, Mar. 4, 1933, Sonderheft, pages 132-135. Recent tendencies in coal firing of industrial furnaces in the metallurgical, ceramic and cement industries are described. Among the metallurgical furnaces the Wesemann, Brackelsberg and Zotos furnace are stressed. EF (23)

Norfolk & Western Railway Co. *Heat Treating & Forging,* Vol. 18, Aug. 1932, pages 491-492. Pulverized coal is used for firing 2 heavy forging furnaces, the waste gases from these being used to heat a preheating furnace. Consumption of coal is 750 lbs./ton of metal heated. MS (23) 6

Forging Furnaces in Railway Smith Shop Use Pulverized Coal. *Steel,* Vol. 91, Aug. 22, 1932, pages 25-27. Pulverized coal has been used successfully in 2 heavy forging furnaces. Advantages are saving in fuel costs, reduction in scaling of metal, increased life of furnace linings, added cleanliness, and elimination of ash problem. It requires 750 lbs. of coal to heat one ton of forgings. JN (23)

Washing Coal for Coking Purposes at Clairton By-product Coke Works. H. W. SEYLER. *Coal Age,* Vol. 38, June 1933, pages 187-194. Equipment and operation of a modern coal washing plant using the Rheolaveur process are outlined. Benefits derived from washing coal for coking purposes are: (1) Reduction of ash and S in coke produced, (2) 10 to 15% improvement in physical qualities of metallurgical coke produced, as determined by the tumbler barrel test, (3) decreased yields of small size coke with a corresponding increase of metallurgical coke, (4) 20% reduction of H_2S content in coke-oven gas, (5) increased yields of by-products, (6) increased porosity of coke, (7) increased mine production due to removal of more top and bottom, and (8) improvements in blast-furnace operations due to improved quality of metallurgical coke. CBJ (23) 7

Utilizing the Heat in Coke by Dry Quenching. Part I. WILLIAM O. RENKIN. *Steel,* Vol. 90, Apr. 25, 1932, pages 23-25; **Part II.** May 9, 1932, pages 31-34. A description of dry quenching process for cooling coke without use of water as developed by Sulzer Bros. in Switzerland, with a comprehensive discussion of advantages of this process over water quenching. Cooling is accomplished by circulating inert gases through the glowing coke and then through a steam boiler where they are cooled and recirculated. Dry quenching produces a better coke which is cleaner and stronger, screens more easily, contains less fines and breeze, is more uniform in size, offers less furnace resistance and better furnace performance, and is more economical to produce and handle. This process yields a saving of 4.17% in coke and an energy saving of 480 B.t.u./lb. of coke produced. Also, the pumping of water and the presence of unpleasant and deleterious vapor clouds laden with dust are eliminated. JN (23) 8

Determination of the Compressive Strength of Coke (Ein Beitrag zur Bestimmung der Druckfestigkeit des Koks) R. SCHMIDT. *Brennstoff Chemie,* Vol. 13, Dec. 15, 1932, page 473. 1 cm. cubes of coke from central parts of coke oven were more resistant to compressive stress than higher samples from other parts. The compressive strength was higher when the pressure was along the longitudinal direction of the chamber and lower if perpendicular to this. All values were considerably higher than those in a blast furnace 25 m. high for which a compressive strength of 3 kg./cm.^{2} usually is desired. EF (23) 9

Eastern Malleable Jobbing Foundry. *Foundry,* Vol. 60, June 1932, pages 26-27, 50. Describes installations of modern type annealing oven fired by powdered coal at the Meeker Foundry Co., Newark, N. J. Castings at present include wrenches, ticket punches, rocker arms, castors, etc. New furnace cuts annealing time ½, is more flexible and reduces operating costs. Soaking period is reduced. Castings made in this furnace are immune to embrittlement on being galvanized. VSP (23) 10

A Few Actual Problems in Furnace Operation in Annealing of Metals (Einige aktuelle Fragen der Ofenführung beim Glühen von Metallen) V. PASCHKIS. *Zeitschrift für Metallkunde,* Vol. 25, Apr. 1933, pages 93-95; May 1933, pages 117-121. A mathematical discussion of heat consumption, possibilities of heat economies, and temperature measurements in heat-treating furnaces. RFM (23)

Open Hearth Furnace Design and Control. Gas-Air Control in Open Hearth Furnaces. V. H. Legg. *Journal Institute of Fuel,* Vol. 6, Aug. 1933, pages 349-357. The importance of regulating flow of gas and air to furnace and of waste gas from furnace as a means of speeding up furnace production, economizing in refractories and saving fuel is shown. A new method for measuring directly the air infiltration through regenerator walls is described, and detailed results are given from 1 regenerator during operation. The resistance of various checker settings in common use is shown. **Economic Regenerators for Open Hearth Furnaces.** Helmut Trinius, pages 357-369. The efficiency of heat regeneration depends upon checker design, together with chamber construction, and factors of latter involved are discussed. Different bricks should be used for different temperature ranges; the limits for different classes of bricks are given. The influence of the most important variables are discussed and shown graphically, including gas velocities, width of flue, thermal conductivity of brick, specific heat and apparent specific gravity of brick, ratio of brick height to breadth, reversal period, fluctuation of temperature during reversal period, and heat utilization of burnt gas. Costs are discussed and most economic shape of brick and design of checkers considered. For open hearth furnaces straight through standard checkers are in general recommended as giving good results consistent with a brick as thin as possible without sacrificing stability of construction. In the upper layers thick bricks must be used to insure durability; in such cases a multi-zone checker offers advantages over a 1-zone checker. A method for calculating multi-zone checkers is given. **The Calculation of Open Hearth Furnace Regenerators.** Herbert Southern, pages 369-380. Mathematical. **Discussion,** pages 380-387. AHE (23)

Economic Regenerators for Open-Hearth Furnaces. H. Trinius. *Iron & Coal Trades Review,* Vol. 126, May 19, 1933, page 790. See *Metals & Alloys,* Vol. 4, Aug. 1933, page MA 264. Ha (23)

Heat Transfer in Recuperators. W. Trinks. *Blast Furnace & Steel Plant,* Vol. 20, Sept. 1932, pages 718-720. See *Metals & Alloys,* Vol. 4, June 1933, page MA 193. MS (23)

Contribution to the Technology of Tar for Steel Mills (Contribution à la Téchnique du Goudron d'Aciérie) R. Francois. *Chimie et Industrie,* Vol. 27, Apr. 1932, pages 780-784. Discusses properties, analysis, and manufacture of special tar used for binding dolomite when making bottom of basic open-hearth furnaces. MAB (23)

Continuous Metal Melting. *Gas Journal,* Vol. 201, Mar. 22, 1933, page 749. Describes a furnace lined with carborundum for continuous melting of Al and other non-ferrous metals. Advantages include low maintenance cost. MAB (23)

Melts Iron in Rotary Furnace. Vincent Delport. *Foundry,* Vol. 60, Sept. 1932, pages 26-27, 63-64. Results obtained in England with rotary furnaces show a definite advantage over the cupola. Armstrong-Withworth completely adopted the new melting process for the whole of its Fe foundry. Describes the 4 units which are fired with pulverized coal. Advantages claimed are: (1) Fe melted in the furnace can attain a temperature as high as 1650° C.; (2) metal is only in contact with refractory lining and is protected from contamination by gases from upper layer of slag; and (3) complete control of C due to high temperature. Effect of super-heating cast Fe is to produce in final material evenly disseminated condition of matrix of pearlite and ferrite, depending on degree and length of superheat. Operation costs are about the same as with cupola. VSP (23)

Making a Small High Temperature Furnace. *English Mechanics,* Vol. 14, June 2, 1933, page 123. Illustrates and discusses how to construct an inexpensive, gas-fired furnace suitable for melting steel, Ni and similar metals. A crucible of steel scrap may be melted and ready for casting in 15-20 min. WH (23)

Melts Iron in 21-Inch Cupola. Gottfried Olson. *Foundry,* Vol. 60, Oct. 1932, pages 17, 56. A 21-in. cupola 84 in. high providing operating rate not possible with larger equipment and producing 2500 to 2800 lbs./hr. is described. It melts gray Fe, semisteel or high-test Fe with steel content of 30-80%, etc. Temperatures of 2800° F. and over have been obtained. VSP (23)

Large Scale Brass Annealing in Automatic Furnaces. *Heat Treating & Forging,* Vol. 18, Aug. 1932, page 486. Chase Company, Waterbury, Conn., has installed a gas-fired, automatic, continuous conveyor furnace having a heating chamber 30 ft. x 5 ft. x 20 in., divided into 3 approximately equal zones. Production capacity is 5000-6000 lb. of brass/hr. Temperatures used are 1100°-1250° F. Overall efficiency on a 24-hr. basis is about 29%. MS (23)

Gas-Fired Unit Bright Anneals Copper Wire in Atmosphere of Steam. J. B. Nealey. *Gas Engineer,* Vol. 57, Sept. 1932, page 519. This new furnace type encloses Cu wire spools in Ag-soldered Cu retort which is scavenged of air and sealed after filling with an inert gas such as H, specially treated town gas or its combustion products, combinations of N and H, etc. This retort is introduced into a radiant heat furnace and the whole brought up to annealing temperature. WH (23)

Furnace Bright Anneals Copper Wire. J. B. Nealey. *Heat Treating & Forging,* Vol. 18, Oct. 1932, pages 599-600. Describes furnace installed by Diamond Braiding Mills, Chicago Heights, Ill. Similar to articles in *American Gas Association Monthly,* Vol. 14, Aug. 1932, pages 336-338; *Gas Age-Record,* Vol. 70, July 30, 1932, pages 111-112; and *Iron Age,* Vol. 130, July 28, 1932, page 143, ad. sec. page 16. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 332. MS (23)

A Simple Bright-Annealing Furnace (Ein einfacher Blankglühofen) L. Frank. *Elektrowärme,* Vol. 3, May 1933, pages 111-112. The furnace is of bell type; the bell of 1100 mm. diameter and 1075 mm. height is removable and is used up to 1000° C. Heating elements are embedded in the hearth. The bell is welded together as a double-cylinder so that cooling air can be sent through the space between the 2 cylinders to effect faster cooling. For an operating temperature between 600° and 850° C. an average of 350 kw. hr./ton was consumed. The cost was 4.8 pfennig/kg. charge at a unit price of 7.2 pfennig. Ha (23)

Sheet Annealing Furnaces, Past and Present. Friedrich Bleiman. *Metallurgia,* Vol. 6, Oct. 1932, pages 179-180, 197. Extended abstract of article from *Stahl und Eisen.* See *Metals & Alloys,* Vol. 4, June 1933, page MA 193. JLG (23)

Bright Annealing Coils of Strip in Mass Production. *Metal Progress,* Vol. 24, Aug. 1933, pages 19-21. Equipment used by American Steel & Wire Co. for bright annealing is described. Atmospheric control and storage of gas and the heat insulation features of the equipment are featured. WLC (23)

Automatic Furnace for the Heat Treatment of Medium and Heavy Plates. H. Fey. *Engineering Progress,* Vol. 13, Nov. 1932, page 243. Description of a plate annealing furnace capable of handling plates from 0.320" to 4.80" gage, and up to 12 tons weight in a single piece. Maximum output of the furnace is 30 tons/hour when starting hot, 20 tons when starting cold. RHP (23)

Heating and Cooling Wire. *Heat Treating & Forging,* Vol. 18, Aug. 1932, pages 484-486. From pamphlet 339 of the W. S. Rockwell Company. Discusses influence of rate and time of heating and cooling on quality and uniformity of product, and selection of fuels. MS (23)

Liquid Baths for Heat Treating—Low-Temperature Salt Baths. W. Paul Eddy, Jr. *Iron Age,* Vol. 130, Oct. 20, 1932, page 613, adv. page 16. Fourth of a series of articles. Divides salt baths into 3 groups: Low-temperature salts, used for tempering and for quenching C or low alloy steels; medium-temperature salts, used for heating the same steels for hardening, normalizing or annealing; and high-temperature salts, used for heating high speed and certain other high-alloy steels for hardening. Low-temperature salt baths are discussed. VSP (23)

Some Applications of Gas in the Metallurgical Industries. C. S. Thane. *Gas Engineer,* Vol. 57, Dec. 1932, page 642. Use of gas for case-hardening, hardening and tempering (salt bath) is urged. WH (23)

REFRACTORIES & FURNACE MATERIALS (24)

Refractories in 1932. *Blast Furnace & Steel Plant*, Vol. 21, Jan. 1933, pages 70-71. Excerpt from progress report of the Iron & Steel Division of the American Society of Mechanical Engineers. MS (24) 1

Thermal Spalling. *Foundry Trade Journal*, Vol. 48, May 25, 1933, page 367. Spalling of firebricks is dealt with briefly and the following points are recommended as worthy of note when the attempt is made to minimize the risk of spalling: (a) Lighting-up should be done with coal fires, wood and oily waste giving too much flame for the surface of cold brickwork; (b) the slowest practicable heating and cooling of the bricks under 800° C.; (c) use of bricks of standard size instead of large special shapes and of shapes with severe changes in mass and section; (d) the adoption of special quality bricks where very fast heating and cooling cannot be avoided. A diagram showing typical expansion curve of fire brick accompanies the article. OWE (24)

Insulation of Open Hearth Furnaces. E. F. ENTWISLE. *Blast Furnace & Steel Plant*, Vol. 21, June, 1933, pages 308-311. Paper read before the American Iron & Steel Institute. MS (24) 2

Longer Life, Higher Strength Shown by New Refractories. *Steel*, Vol. 92, Jan. 2, 1933, pages 98-99. Reviews progress made during 1932 in refractories. MS (24)

Importance of Insulation on Furnaces. BERNARD THOMAS. *Heat Treating & Forging*, Vol. 19, Oct. 1933, pages 49-51; Nov. 1933, pages 78-79. Discusses principles underlying use of insulation for industrial furnaces working at temperatures higher than 700° F. Deals with theory, materials and forms available, and method of application, and gives an example of the savings effected. Use of a 4½" thick wall of insulating brick and an insulated base on a producer gas-fired pot furnace for hardening steel tools resulted in a 23% reduction in gas consumption; 30.8% less time required for furnace to reach working temperature at beginning of each day; and 10.1% increase in output. MS (24) 3

New Refractory "Siemensite" will not Fuse at Cone 42. *Iron & Coal Trades Review*, Vol. 126, June 2, 1933, pages 857-859; *Brick & Clay Record*, Vol. 82, Mar. 1933, page 88. This refractory consists mainly of 20-40% chromium oxide, 18-30% magnesium oxide, 25-45% alumina and 8-14% other constituents. The softening point lies above 3300° F., the fusion point higher than 3660° F. It is very dense material without noticeable pores and with a glassy or fine or coarse crystalline structure, according to the manufacturing process. At 3000° F. it showed a remarkable resistance against basic as well as acid and alkaline slags. Details of construction in furnace are illustrated. Ha (24) 4

New Uses for Aluminium Oxide. *Chemical Markets*, Vol. 33, Sept. 1933, pages 223-224. A brief note on the use of alumina as a refractory, absorbent, abrasive and catalyst. RAW (24)

Silica as Refractory Material. C. N. WITHEROW. *Brick and Clay Record*, Vol. 82, Apr. 1933, pages 123-124, 137; May 1933, pages 164-165, 171; June 1933, pages 208-209. The fundamental properties of silica and its behavior in different refractories are discussed, physical constants of silica minerals are tabulated and places of deposits given. Manufacturing methods to improve silica bricks are discussed. Ha (24)

Evolution of the Russian Magnesite Industry (Entwicklungswege der russischen Magnesitindustrie) N. A. DJUKALOW. *Feuerfest-Ofenbau*, Vol. 9, July/Aug. 1933, pages 105-111. Data on sinter magnesite, magnesite bricks and caustic magnesite since 1928 and estimates up to 1937 according to the Russian five year plans are compiled in 21 tables. EF (24) 5

GASES IN METALS (25)

Thermal Effects Produced by the Exposure of Massive Gold to Saturated Water Vapor. FREDERICK BARRY & ELLIOTT PIERCE BARRETT. *Journal American Chemical Society,* Vol. 55, Aug. 1933, pages 3088-3098. A calorimetric method is described which permits the measurement, to within ± 0.0005 gram cal., of heats produced by the exposure of metals to vapors. MEH (25)

Some Causes of Defects in Aluminum Alloys (Quelques Causes de Défauts dans les Alliages d'Aluminium) C. E. HANSON. *Bulletin de l'Association Technique de Fonderie,* Vol. 16, Aug. 1932, pages 431-444. British exchange paper at World Foundry Congress, Paris, Sept. 1932. Absorbed gases produce defects in aluminum alloy castings. H and H_2O vapor are worst gases. H_2O may be present in crucibles, linings, products of combustion, or air. Under certain conditions, Al before melting may absorb gas and give bad castings later. Treatment of molten metal and control of melting and pouring conditions help to prevent gas absorption. 14 references. WHS (25)

Oxygen in Metallurgical Products (L'oxygène dans les produits sidérurgiques) JEAN COURNOT & LOUISE HALM. *Génie Civil,* Vol. 101, July 1932, pages 7-11, 32-34. A survey of the field as seen in the contemporary literature. JDG (25)

Effect of Hydrogen on Transformer Sheet (Einfluss von Wasserstoff auf Transformatorenstahl) W. S. MESSKIN & J. M. MARGOLIN. *Archiv für das Eisenhüttenwesen,* Vol. 6, Mar. 1933, pages 399-405. 4% Si transformer sheet was heated in H at temperatures up to 450° C. under pressures up to 650 atmospheres. The H absorbed raised the coercive force and watt loss and lowered the permeability the effect being greater the higher the temperature and pressure. Heating in H 96 hours at 450° C. under 200 atmospheres raised the coercive force and watt loss over 100% and 50% respectively and lowered the permeability over 50%. After heating at the higher temperatures and pressures the effect of the H absorption was only reduced appreciably by heating at 700°-800° C. in air or vacuum. After heating at lower temperatures and pressures, however, the effect of the H was removed by holding at 100° C. for an hour. The decided brittleness produced by the H treatments was attributed to fissures caused by the formation of methane and water vapor in the interior of the sheet. SE (25)

Decomposition of N_2O on Incandescent Pt and Pt-Ir (Zum Zerfall von Stickoxydul an glühendem Platin und Platin-Iridium) J. LÜCKE & R. FRICKE. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 20, Apr. 1933, pages 357-360. Experimental results on Pt being in accordance with previously published observations of Schwab & Eberle (*Zeitschrift für physikalische Chemie,* Abt. B, Vol. 19, Oct. 1932, pages 102-106) experiments on an 90/10 Pt-Ir alloy were undertaken. Due to mechanical surface treatment, the catalytic action of the Pt-Ir wire was increased. This is ascribed to the formation of fresh active centers. The untreated Pt-Ir catalyzer yielded the same results as gained on plain Pt wires. EF (25)

Note on the Influence of Volatile Chlorides on Copper. J. D. GROGAN & T. H. SCHOFIELD. *Foundry Trade Journal,* Vol. 48, Mar. 23, 1933, page 210. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 334. OWE (25)

Nomenclature of Gases in Metals. Correspondence from T. D. YENSEN. *Metals & Alloys,* Vol. 4, Apr. 1933, pages 44, 48. The reasoning behind present inclusive term "gases in metals" is criticized. Improved descriptive terms are suggested as follows: I. Inclusions. (a) Gaseous inclusions (gases in blowholes). (b) Solid inclusions (carbides, nitrides, oxides, sulphides, phosphides, hydrides, and graphite.) II. Impurities in Solid Solution (C, O, H, N, S, P in atomic dispersion). WLC (25)

Permeability of Hydrogen through Steel at 700° to 1000°C. (Wasserstoffdurchlässigkeit von Stahl bei 700 bis 1000°) G. LEWKONJA & W. BAUKLOH. *Archiv für das Eisenhüttenwesen,* Vol. 6, Apr. 1933, pages 453-457. Armco-iron and 0.1 to 1% C steel cylinders were filled with H_2, heated, and the decrease in pressure due to diffusion of H_2 measured. Diffusion increased rapidly at temperatures above 850° C. The permeability increased with C content and decreased the greater the wall thickness and the grain size. H_2 appears to diffuse along the grain boundaries. After decarburization by H_2 the permeability decreased. An Al coating 0.5 mm. thick made a steel impermeable to H_2 at 850° C. 21 references. SE (25)

Improvements in the Vacuum Fusion Method for Determination of Gases in Metals. LEWIS REEVE. *Contribution No. 56, American Institute Mining & Metallurgical Engineers,* July 1933, 21 pages. Gases were collected and then analyzed. Instead of setting on a refractory plug the graphite crucible was suspended so that only a small portion was in contact with the refractory. This prevented excessive reaction between graphite and refractory. A complete determination of gases in steel could be made in 3 hr. A new graphite crucible was used for each melt. It was found that the amounts of the different oxides in the steel could be determined by fractional distillation. A sample was mixed with Sn and the amount of gas given off at several different temperatures determined. It was found that FeO was reduced at 1000° to 1050° C., MnO at 1150° C., SiO_2 at 1300° C., and Al_2O_3 at 1550° to 1600° C. The total O given off at different temperatures was the same as that given off at the usual temperature of carrying out analyses. More H, however, was given off when the extraction was performed in steps. Not all of the N was given off at the low temperatures. Results obtained by fractional fusion agreed fairly well with those obtained by electrolytic extraction. JLG (25)

Gas Content of Aluminum Casting Alloys (Gasgehalte in Aluminiumgusslegierungen) H. NIPPER. *Zeitschrift für Metallkunde,* Vol. 25, Mar. 1933, pages 65-67. Brief review of research at the Technische Hochschule at Aachen on the effect of melting and casting conditions upon the density, gas content, and strength of Al and Silumin castings. Eleven conditions affecting the properties of the castings are enumerated. The effect of a number of these conditions was studied. It is found that a protective salt layer during melting is useful only when the metal is heated unusually high; over-heating increases the gas content (H_2, CO, CO_2 formed by vacuum fusion) though density and strength do not seem to be determined directly by gas content; diminution of pressure and repeated melting have good effects; gassing with N_2 or Cl_2 increases the density, though subsequent additions of Mg and Ca are ineffective; gassing with Cl_2 after modification of Silumin increases density (the effect of various treatments upon the microstructure of Silumin is shown); H_2 and illuminating gas played upon the surface of the molten metal is without effect; increase in melting and casting temperature affects the gas content very little; Al cast in hot dried sand contains less gas than that cast in green sand; gas extracted from Al is 3.58 to 7.06 cc./100 g., of which 77.5 to 82% is H_2 (15% CO, 6% CO_2); for Silumin these figures are 2.26 to 3.44 cc./100 g. and 70-71% (22% CO, 8% CO_2). RFM (25)

Behavior of Steel in Sulphur-Containing Atmospheres at Forging Temperatures. D. W. MURPHY. *Transactions American Society for Steel Treating,* Vol. 21, June 1933, pages 510-531. Paper presented at Buffalo Convention, Oct 1932. Test runs on 11 types of steel to determine effects of SO_2 and H_2S in various atmospheres, burning city gas and air, at 2000°-2450° F. are presented in tables and graphs. SO_2 affects steel to greatest extent, increasing scaling losses and S content in outer layers much more than H_2S. Increasing time, temperature and % SO_2 increase effects. Oxidizing nature of atmosphere is an important factor in increasing diffusion of S in steel, 12% CO_2 greatly reducing scaling loss and penetration. Ni steel is subject to more adverse effects than either plain C or Cr steels. H_2S in an oxidizing atmosphere will increase scaling loss and penetration of sulphides similar to SO_2. A high limit of 0.5% S in a reducing atmosphere is recommended for forging fuels. Includes discussion. 8 references. WLC (25)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

Effect of Small Titanium Additions to Structural Steel (Einfluss eines geringen Titanzusatzes auf Baustähle) J. AREND & M. LOBE. *Stahl und Eisen,* June 8, 1933, pages 604-606. The steels studied were made in a 10-ton open-hearth furnace; two were C steel with 0.1 and 0.25% C; two Cr steel with 0.15% C and 0.7% Cr; one a Cr-Ni steel with 0.13% C, 0.7% Cr, and 3.5% Ni. The effect of Ti additions up to 0.4% Ti on the strength and ductility in the annealed and in the quenched condition were determined. In the C steels the yield point and tensile strength increased considerably with the addition of Ti, but in the alloy steels the effect of Ti was negligible. No precipitation hardening was observed. SE (27)

High Strength Iron—Control of Alloying Elements. H. BORNSTEIN. *Metal Progress,* Vol. 23, June 1933, pages 37-41, 60. The effect of the ordinary elements in cast Fe are described. Ni in the range 0.25 to 5% acts as a graphitizer. Small amounts reduce chill by suppressing free carbide. Larger amounts harden Fe forming a matrix of sorbite and martensite. Ni increases the machinable range of hardness, promotes density and freedom from porosity because less Si is necessary, gives more uniform grain, hardness, and strength, in thick or uneven sections. In the range of 10 to 18%, Ni gradually changes the structure to non-magnetic gamma Fe. Austenitic gray Fe is nearly free from growth and scaling at 1500° F., and is corrosion resistant. Cr is a carbide former, increasing the combined C and tendency to chill, and helps form finer and harder pearlite. Above about 1% Cr, free carbides form, hindering machining. 3% Cr cast Fe has entirely white fracture. Cr increases tensile strength and reduces tendency to growth at elevated temperatures. Mo is a less drastic carbide former than Cr, reduces size of graphite flakes, and increases strength and toughness of cast Fe. 2 micrographs show the effect on graphite. Mo aids in heat treating cast Fe, the pearlitic structure approaching the sorbitic with sufficient Mo. The critical transformation is retarded making volume changes less drastic and the rate of graphitization slower. V in amounts of 0.1 to 0.5% is a carbide stabilizer similar to Cr. Ti resembles Si as a graphitizer, but has stronger effect in smaller amounts. High strength Fe is melted in the cupola, air furnace, or electric furnace. Tensile strength of 50,000 lbs./in.^{2} is common practice. C is lower than ordinary gray Fe, less than 3%. Some typical analyses are tabulated. Closer metallurgical control is necessary for high strength Fe. Some patented cast irons and others for particular uses are described. WLC (27)

Clean Iron and Steel with Alloying Agents. R. C. GOOD. *Foundry,* Vol. 60, Jan. 15, 1932, pages 22-24. Abstract of paper read at the Cleveland Meeting of the Ohio Foundries Association. Deals with the effect of alloys on Fe and steel with particular reference to those alloys acting as scavenging agents. Of all alloys Si and Mn receive the most attention. These alloys combine with oxides and gas, and when added in sufficient amounts dissolve in the Fe and impart distinct characteristics. VSP (27)

Effect of Various Alloying Elements on the Graphitization of Cast-Iron (Einfluss verschiedener Legierungselemente auf die Graphitbildung im Gusseisen) O. v. KEIL & F. EBERT. *Archiv für das Eisenhüttenwesen,* Vol. 6, June 1933, pages 523-524. The carbon content at which finely divided eutectic-like graphite first formed in alloyed cast irons, cooled at constant rates, was determined. Al, Mn, Ni, Cu, V, and Si promoted graphitization in the order named. Mn and V showed a maximum graphitizing effect at about 4% Mn and 0.5% V respectively, this being attributed to the formation of the carbides of these elements beginning with these compositions. SE (27)

The Effect of Different Elements on the Annealing and Grain-Growth Characteristics of Alpha Brass. MAURICE COOK & HERBERT J. MILLER. *Metal Industry,* London, Vol. 41, Sept. 30, 1932, page 324; *Engineering,* Vol. 134, Sept. 30, 1932, page 395. Abstract of paper read before the Institute of Metals, Sept. 1932. See *Metals & Alloys,* Vol. 4, May 1933, page MA 159. LFM + Ha (27)

Alloying Elements in Malleable Iron. FREDERICK L. COONAN. *Foundry,* Vol. 60, Oct. 1932, pages 43-44. Abstracted from Abstracts of scientific and technical publications from the Massachusetts Institute of Technology, Jan. 1932. Purpose of investigation was: (1) To determine effect of certain alloying elements on properties and microstructure of malleable cast Fe; and (2) determine possibility of developing an alloyed malleable Fe that can be surface hardened by N. Results show that Al, Ni, Cr, V and Mo when used alone in material do not materially affect hardness of product when nitrided. Using combinations of these elements in conjunction with Al, product possessed hardness when nitrided. 1% each of Cr and Al with low % C and Si produces product, when nitrided, tougher than that formed in higher C—high Si alloys. Combination of Al with Ni or Mo showed little promise. VSP (27)

How Casting Temperature and Addition of Iron Affect Bearing Bronze. *Iron Age,* Vol. 129, Feb. 11, 1932, page 391. Investigation conducted by the Bureau of Standards. It was found Fe additions over 0.3% were detrimental to bronze. Small addition of Fe (up to 0.5%) decreased resistance to wear and increased hardness. When Fe content exceeded 0.3% segregation of Pb articles occurred, grain size reduced and decreases were noted in notch toughness. Addition of Fe up to 1.0% increased resistance to pounding. An 80-10-10 bronze was used in the investigation. VSP (27)

The Nickel Age. (De eeuw van het nikkel.) A. VOSMAER. *Polytechnisch Weekblad,* Vol. 26, Jan. 1933, pages 17-19. Among discoveries on effect of Ni in steel, those of Hadfield (1886) and Riley (1896) are stressed. Then the use of Ni in steel, cast Fe, ferro-nickel, non-ferrous alloys and as pure metal is taken up. WH (27)

Effect of Aluminum on Cast Iron (Über den Einfluss von Aluminium auf Gusseisen) E. PIWOWARSKY & E. SÖHNCHEN. *Metallwirtschaft,* Vol. 12, July 21, 1933, pages 417-421. Al influences the Fe-C system similarly to Si. It raises the eutectic temperature. Up to about 2.5% it displaces C from the melt to a greater extent than Si, above 2.5% Si has a greater effect than Al. The solubility of C in solid Fe is also reduced by the addition of Al. Graphite formation begins at about 1% Al, reaches a maximum at 3 to 4%, and disappears again at 11% Al. The Brinell hardness curve is directly opposite to the graphite curve. Microscopic examination shows a white constituent having great corrosion resistance above 6% Al. It is not believed to be Al_4C_3 but an Fe-Al constituent formed by segregation. Cast iron containing 3.8% C and .1% Si was alloyed in graphite crucibles with up to 20% Al. To some of the samples more Si was added. The alloys oxidize readily with the formation of Al_2O_3 and become viscous. Annealing boxes were cast from alloys of 10 to 20% Al. Those shaken out of the molds while hot cracked later on heating while those shaken out when cold did not. Between 10 and 16% Al the white constituent was again observed. Graphite formation reaches a maximum at 2 to 3% Al, disappears at 10%, and reappears at 18.4%. The tensile and transverse strength increase with the addition of Al to a maximum at 4%, then gradually decrease. The coefficient of expansion is increased by Al. The resistance of cast iron to corrosion by HCl and HNO_3 is increased considerably by Al, especially over 10%. However the attack by molten NaOH is increased by Al. The effect of Al on scaling was determined by heating cylinders at 850°, 1000° and 1100° C. in an air blast and determining the gain in weight. The scaling reaches a maximum at 2% Al then drops to almost nothing at 10% Al and remains very low up to 20%. The growth of cast iron is increased by Al additions up to 4-5% then decreases with higher Al. Cast iron with 10 to 20% Al is commercially important on account of its corrosion and heat resistance. 15 references. CEM (27)

Role of Phosphorus in Cast Iron (Contribution à l'etude du role du phosphore dans les fontes) J. Dessent & M. Kalan. *Bulletin de l'association Technique de Fonderie,* Vol. 7, Feb. 1933, pages 61-64. P has a great affinity for Fe. In liquid state they mix in all proportions. In solid state Fe can dissolve up to 2.8% P. Alloys in range 2.8-10.2% P solidify in form of primary crystals of solid solution (2.8% P) surrounded by eutectic solid solution of Fe_3P (15.58% P), steadite. Solid solubility of P in Fe drops from 2.8 to 1% at 700° C. In range between 900° and 1400° C. there are found 3 different fields in the binary alloys; the α, $\alpha + \gamma$, and the γ fields. The ternary system, Fe-P-C was studied by Stead, Wust, Goerens, Dobbelstein and Vogel. P lowers total C. Up to 2.5% P no effect is produced on graphite precipitation. GTM (27)

Study of Low Carbon Cast Irons. Influence of Silicon and Manganese Contents in the Pearlitic Range Corresponding to a Normal Cooling Rate (Contribution a l'Etude des Fontes à Bas Carbone. Influence des Variations de Teneurs en Silicium et en Manganèse sur ces Fontes dans l'Intervalle de sécurité Perlitique Correspondant à une Vitesse Normale de Refroidissement) H. Portier. *Bulletin de l'Association Technique de Fonderie,* Vol. 6, July 1932, pages 323-332. Read before World Foundry Convention, Paris, 1932. Lowering the total C of gray cast iron reduces graphite content, refines graphite present and, consequently, improves strength of material. For a given cooling rate, this C lowering broadens pearlitic range. Action of low C content on liquidus temperature is compensated by a higher Si content. Mn being without effect on this temperature, a cast iron with 2.6% total C can easily be obtained in cupola. This Fe will freeze a little more rapidly, the freezing range being shortened by increasing Si. Higher mechanical properties (transverse and shear strength and Brinell) are reached with about 2.5% Si, Mn content being kept low. These properties decrease with increasing Mn contents. But castability (runnability) and hardness of chilled Fe increase as Mn contents increase. Si has but a negligible action on structure of cast iron which for composition range studied, is purely pearlitic. An increasing content of Mn refines pearlite, holds graphite in a finely divided state, drives away ferrite which is replaced by cementite, and causes some MnS to appear. Structural heterogeneity, due to a slight boundary transcrystallization which does not exist with low Mn content, increases with increasing Mn content, this effect counterbalancing somewhat the constitution heterogeneity. Combined C and eutectoid C decrease when Si and Mn increase. Graphite content in low C cast iron is about the same as in ordinary cast iron for the same cooling rate, this being of interest for the hardness as well as for the machinability point of view. Cast iron of the following composition total C = 2.5-2.6%, Si = 2.25-2.75%, Mn = 0.5-1% has a sufficiently low melting point to be easily produced in the cupola. It possesses a normal castability, shows a low heterogeneity of depth (difference of properties in various points of the same section), a perfect homogeneity of thickness (similarity of properties in the center of various sections of different thickness) and very good mechanical properties. Although machinable, an iron of this composition is not so easily machined as ordinary cast iron. As chilled it possesses the same hardness as chilled cast iron rolls. FR (27)

Effect of Cadmium on the Properties of the Copper Conductors. S. A. Pogodin. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 6, 1933, pages 287-288. The electrical and mechanical properties of the Cu-Cd alloys with 0.15-0.98% Cd has been investigated. The cold-worked wire with 0.98% Cd has the tensile strength 60 kg./mm.^{2} and electrical conductivity 85.5% of standard copper. The cold-hardened Cu-Cd wire retains its mechanical properties up to 250° C. (30 min. annealing). NA (27)

INSTRUMENTS & CONTROLLERS (28)

Measuring Temperature of Molten Cast Iron. W. H. Spencer. *Whiting Founder,* Vol. 1, No. 3, 1932, pages 3-4. Review and brief description of instruments used in measuring temperature of molten metals by immersion thermocouples, radiation and optical pyrometers, corrections to be made on the readings are explained and examples given. Ha (28)

Impact Testing Machine with a Differential Acceleration Recorder. Kameichi Yuasa. *Journal Society of Mechanical Engineers Japan,* Vol. 36, June 1933, pages 378-382. Paper read before the 209th Meeting of the Society of Mechanical Engineers, Jan. 23, 1933. This impact testing machine described involves 2 bodies, only one of which strikes the test piece. The other body is moved parallel to the first one but has a known and definite motion. A method of recording the magnified difference of displacement between these 2 bodies and that of recording the magnified difference between a multiplied value of displacement of the second body and that of the first body are described. Experimental results are given. Kz (28)

Measuring Smoothness by Optics. Albert Portevin. *Metal Progress,* Vol. 23, June, 1933, pages 44-45. Surface conditions are important in studies of corrosion, electroplating, friction, impact and fatigue. Scientific determination, by microscope under varying light, gelatine molds of the surface, magnifying the movements of a fine point resting on the surface, and sound waves using a sapphire point on the moving surface, are not practical. Measured by the more practical photoelectric cell, the degree of polish is not exactly defined, though sand blasted surfaces are easily measured. Estimates of the result of corrosion on surfaces is limited in usefulness because of intergranular corrosion. Etching colors must be measured in monochromatic light and through monochromatic filters. These colors are due to films whose thickness may be calculated if the refractive index is known. Tempering color analyses show the difference in oxidation speeds at working temperatures. WLC (28)

Some Aspects of the Use of Measuring Instruments for Fuel Control in the Iron and Steel Industry. M. Koopman & N. Turner. *Journal Institute of Fuel,* Vol. 6, Aug. 1933, pages 388-398. The various types of measuring instruments used in Fe and steel practice are described, including pressure, rate of flow, temperature (many types of each of these 3), gas analysis, calorific value of gas, density of gas, moisture, dust, etc. AHE (28)

Aging of Nickel-Chromium Nickel Thermocouples (Alterung von Nickel-Chromnickel-Thermoelementen) A. Grunert. *Die Chemische Fabrik,* Vol. 6, Jan. 18, 1933, pages 39-40. Thermocouples made of Ni and Cr-Ni wire which had been melted in a vacuum furnace were kept at 1150°, 1175°, and 1280° C. for 170 hours continuously and checked against Pt, Pt-Rh couples. During this time there was no noticeable variation in the readings obtained. This agrees with results obtained in industrial installations. To obtain such results the wire must be properly made. It must be vacuum melted, the Cr content must not be too low and the impurities must be kept low. It can be used up to 1300°, but over 1100° must be protected from the air by suitable protection tubes. CEM (28)

Bar and Rod Heating Closely Controlled by "Electric Eye." F. C. Cheston. *Iron Age,* Vol. 130, Oct. 20, 1932, pages 618-619. Considerable progress has been made the past year in control of temperature of steel by use of photoelectric cell. It can be arranged to operate on any color during heating process and it will control the temperature within ± 10° F. Adjustment to cause the "eye" to operate on different colors is obtained through a dial. Tubes have a life of approximately 20 years. VSP (28)

The Need and Development of Measurement in the Steel Industry. G. H. Barker. *Metallurgia,* Vol. 8, July 1933, pages 71-72. Considers recording and controlling instruments. JLG (28)

Density of Smoke in Stacks Is Measured by Photocell. R. D. Bean. *Steel,* Vol. 91, Sept. 19, 1932, pages 24-26. This device measures the density of smoke in flue gases by permitting a portion of the flue gases to pass between a source of light and a photoelectric cell. The variation of current in the cell may be read on a recording potentiometer or on a millivoltmeter. The device may also operate a set of bells or signal lights. JN (28)

EFFECTS OF TEMPERATURE ON METALS & ALLOYS (29)

Thermalelectric Properties of Platinum-Rhodium Alloys. Frank R. Caldwell. *Bureau of Standards Journal of Research,* Vol. 10, Mar. 1933, pages 373-380. Thermal electromotive forces and thermalelectric powers of a series of Pt-Rh alloys against pure Pt have been determined from 0°-1200° C. Results are compared with those obtained by other investigators. Materials used in this work contained following percentages of Rh, 0.100, 0.500, 1.000, 5.00, 21.6, 39.0, 51.6, 56.6, 61.2, 80.7, and 100.00. WAT (29)

Influence of Recrystallization Temperature and Grain Size on the Creep Characteristics of Non-Ferrous Alloys. C. L. Clark & A. E. White. *Metal Industry,* London, Vol. 41, Sept. 2, 1932, pages 225-228; Sept. 9, 1932, pages 249-250. See *Metals & Alloys,* Vol. 4, June 1933, page MA 196. Ha (29)

Thermal Expansion of Heat-Resisting Iron Alloys. J. B. Austin & R. H. H. Pierce, Jr. *Industrial & Engineering Chemistry,* Vol. 25, July 1933, pages 776-779. Measurements have been made of the linear thermal expansion of commercial, rather low-C, Fe-Cr alloys containing approximately 1, 5, 17, and 27% Cr, respectively, and on Fe-Cr-Ni alloys containing 18-8, 18-12, and 25-12% of Cr and Ni, respectively. Data on the expansion of stabilized (Ti-bearing) 18-8, a cold-worked 18-8, a 25-12 alloy with 2% Mn, and a mild-C steel are included. The expansion of ferritic alloys appears to be lower than that of austenitic alloys. MEH (29)

Copper-Nickel Alloy with Silicon for Slide Valves (Siliziumhaltige Kupfer-Nickel Legierung für Dampfschieber) *Die Wärme,* Vol. 56, Apr. 8, 1933, page 214. A 50 Ni, 34 Cu, 16 Sn alloy previously employed showed favorable properties at elevated temperatures, but involved some manufacturing difficulties. While Fe, Mn, Sb, Zn and Bi exerted but insignificant effects, marked results were secured with Si. The following alloys yielded the best results: 50 Ni, 39 Cu, 8 Sn, 3 Si and 65 Ni, 27.5 Cu, 4 Sn, 3.5 Si. The Brinell hardness of 350 at 20° C. dropped to only 320 at 450° C. Replacing Sn by Si in ordinary 84/16 CuSn alloys results in a gain of strength at elevated temperatures as shown by the following data:

	20°C.	350°C.	450°C.
84/16 CuSn alloy	134	52	13.5
90.75/6.3/2.95 CuSnSi alloy	150	96	42

EF (29)

Effect of Thermal Stresses in Rails (Über die Wirkung von Wärmespannungen im Eisenbahngleis) H. von Sanden. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 87, Oct. 1, 1932, pages 368-371. Mathematical treatment of the problem whether and under what conditions a vertical warping of rails takes place at sufficiently large temperature changes. Lateral warping is theoretically dealt with. EF (29)

Strength at Elevated Temperatures (Dauerstandsfestigkeit und Warmfestigkeit) Krüger. *Die Wärme,* Vol. 56, Jan. 21, 1932, pages 33-37. German testing methods for determination of creep resistance are compared and correlation of yield point at elevated temperatures to creep resistance is pointed out. Practical experiences gained on behavior of materials at elevated temperatures are discussed, mainly referring to previous statements of Maguerre, Schöne, Thum & Holdt, Moore & Jasper, and Tapsell. 17 references. EF (29)

Measurements with the Help of Liquid Helium. XIX. Investigation of the Alloy Series Lead-Thallium and Lead-Bismuth with respect to Superconductivity (Messungen mit Hilfe von Flüssigem Helium. XIX. Untersuchungen der Legierungsreihen Pb-Tl und Pb-Bi in bezug auf Supraleitfähigkeit) W. Meissner, H. Franz & H. Westerhoff. *Annalen der Physik,* Series 5, Vol. 13, 1932, pages 967-984. The electric conductivity of Pb-Tl and Pb-Bi alloys was investigated as a function of concentration at the temperature of liquid He and the discontinuity points were determined. The mathematical relations were derived. Ha (29)

Effect of Thermal Treatment on the Characteristics of Black-Heart Malleable Iron. Tario Kikuta. *Transactions American Foundrymen's Association,* Vol. 3, Nov.-Dec. 1932, pages 401-443. See *Metals & Alloys,* Vol. 4, July 1933, page MA 237. CHL (29)

Avoiding Overheating of Superheater Tubes. E. Ingham. *Mechanical World & Engineering Record,* Vol. 92, Dec. 23, 1932, pages 597-598. Overheating shortens life of superheater tubes, and may be caused by insufficient steam flow or a non-conductive coating. Overheating may be started by wrongly proportioned surfaces, and will then cause oxidation which results in further overheating. The author details conditions which must be complied with if overheating is to be prevented. Kz (29)

Hardness of Low Melting Alloys at Different Temperatures. V. P. Shishokin & V. A. Ageeva. *Tzvetnuie Metallui,* Feb. 1932, pages 119-136. II. Binary Alloys Whose Components Combine Chemically. (Part I in *Tzvetnuie Metallui,* 1930). Following alloys made of purest materials were investigated: Pb-Bi; Tl-Bi; Tl-Pb; Te-Bi, and also pure Al, Mg and Te. For all systems the following data determined: Brinell hardness at various temperatures, melting points, and temperature coefficients of hardness. The specimens were previously annealed for 100 to 200 hours at temperatures between 100° and 250° C. (1) The hardness curves of the system Pb-Bi at room temperature showed maxima at 25, 40 and 80% Bi, and maxima at 35 and 50% Bi. With rising temperatures hardness decreased, and minima and maxima flattened out gradually. The minimum, observed at room temperature at 50% Bi, with rising temperature is gradually displaced toward eutectic composition (56.25% Bi). The minima are due to formation of compounds. Temperature coefficient of hardness shows a maximum at eutectic composition. (2) Tl-Bi. The room temperature hardness curve shows a maximum at 23.6% Tl and a minimum at 35.5-37.5% Tl, indicating an intermetallic phase. The maxima and minima gradually flatten out and disappear with rising temperatures. The temperature-coefficient-of-hardness curves show a minimum corresponding apparently to an intermetallic phase, and 2 maxima corresponding to 2 eutectics. Logarithmic hardness curves for high Tl alloys have a break indicating a transformation in Tl-rich alloys. (3) Tl-Pb. Hardness curves showed a flat maximum at 28-40% Pb, flattening out at high temperatures. The temperature coefficient of hardness is rather uniform, with a minimum at the above composition, and a maximum at 70% Pb. (4) Te-Bi. Hardness curves showed sharp maxima at 49.1 and 90.7% Te, and a minimum at 60% Te. This system represents a unique case among metallic systems in that the hardness of the compound Bi_2Te_3 (60% Te) does not exceed the hardness of the components. Temperature coefficient of hardness is a minimum at 60% Te and maximum at 90% Te. Consideration of above results indicated that formation of intermetallic compounds, in almost all cases investigated, is shown by the minima in temperature coefficient of hardness. The study of hardness of metals at elevated temperatures made it possible to determine certain relationship between the temperature coefficient of hardness and following properties: melting point, atomic volume, coefficient of expansion, and hardness. This relation is given for Mg, Al, Zn, Cd, Sn, Te, Tl, Pb, Bi in tables and curves based on the authors' results and on data from literature. With the exception of Te and Bi, the atomic volume varies inversely with hardness. With the exception of Sn, the temperature coefficient of hardness curves run parallel with change in coefficient of expansion, and the change in attractive atomic forces. Inverse proportionality is found between the temperature coefficient expansion and the melting point. This is in agreement with the empirical generalization of Grüneisen, that the total percent change in volume from abs. zero to the melting point is the same for all elements. In the binary eutectic systems the temperature coefficient of hardness is higher than in pure metals, the maximum coefficient being observed in eutectic and nearly eutectic compositions. BND (29)

REDUCTION METALLURGY (31)

Recent Experiences on Metal Stack Furnace, Particularly with Reference to Smelting of Nickel Ores (Neuere Betriebserfahrungen mit dem Metallschachtofen, insbesondere beim Schmelzen von Nickelerzen) W. Savelsberg & J. Bunte. *Die Metallbörse*, Vol. 23, Feb. 4, 1933, pages 145-146; Feb. 11, 1933, pages 177-178; Feb. 18, 1933, pages 209-210. In smelting a Greek Ni ore of the following composition: 6.7% NiO, 37.5% Fe_2O_3, 40-42% SiO_2, 9.5% Al_2O_3, 1.0% CaO, 0.9% MgO, 2.5% loss on ignition, the viscosity of the experimental slag mechanically withheld as matte about 20% of the Ni charged. Dolomitic limestone, containing 14% MgO and 34% CaO, added to the ore reduced Ni losses to 10%. Melting in furnaces of annular cross section yielded better results than in square furnaces. The relative output was 20% higher, the slag contained only 0.40% Ni instead of 0.45% and the resulting matte was higher in Ni (2%) and S (2%) and lower in Fe (4%). The annular furnace is limited to a maximum diameter of 1 m. A detailed heat balance is computed, which reveals that reduction equilibria prevailing during smelting of a Ni matte from an ore are identical with conditions in an Fe blast furnace. EF (31)

Recovery of Vanadium from Slag (Über die Gewinnung von Vanadium aus Schlacke) E. Pallas. *Die Metallbörse*, Vol. 23, Feb. 25, 1933, page 243. V is recovered from slags from acid Bessemer and open hearth process by crushing, roasting, leaching and precipitation. All of V present in Ti magnetite enters the Fe to give a pig containing 0.5-0.6% V, of which about 86% is found in the slag after Bessemer process. Roasting in Cl and leaching yielded 90-95% V_2O_2 at Dnjepropestrowsk. The same method gave only 16% of V present in open hearth slags (9-12% V_2O_2). If the slag is mixed with 10% $CaCO_3$ and roasted for 2-3 hrs. at 800°-850° C., removed from furnace, mixed with an additional 15% $CaCO_3$ and roasted for 2-3 hrs. at same temperature, 75-85% of the V is soluble. Charge is leached with $NaCO_3$ solutions, starting with a concentration of 0.5% Na_2CO_3. Cr does not interfere since V is precipitated as K-vanadate. Frequent stirring and avoidance of sintering greatly improve the output. EF (31)

Ferrovanadium From 0.1% Ore. B. M. Suslov. *Metal Progress*, Vol. 23, June 1933, page 47. Catalytic V has been produced since 1931 at the Rare Metal Works in Moscow as a by-product from Ra ore. The production is small and geological surveys reveal no other deposits of a workable % of V. The Kerch Steel Works in the Crimea operates on hydrated phosphoric ore containing 0.11 to 0.17% V_2O_3. Ore is dried and sintered and reduced to pig Fe of 0.11 to 0.14% V. A ladle of pig Fe is oxidized with 2.5% its weight of low P ore. 1/3 the V is oxidized into liquid slag equal in weight to ore used and analyzing 10 to 20 times as high in V as the pig Fe. The slag is mixed with 10% of NaCl, ground, and roasted at 1500° F. for 3-4 hr. Three-fourths the V is converted into soluble $NaVO_3$ which is leached with hot water. Phosphates are precipitated by Mg salts and filtered out. CaO is added to the hot solution, mixture agitated with steam, and insoluble $Ca(VO_3)_2$ settles out. By electric smelting with ferro-Si, standard 40% ferro-V is obtained. The V extracted amounts to 25% of the V in the pig Fe. The experimental plant treats 5 tons of slag daily. WLC (31)

Volatilization of Impurities from Zinc Concentrates. G. L. Oldright, W. E. Keck & F. K. Shelton. *United States Bureau of Mines Report of Investigations* 3218, June 1933, pages 1-30. Under experimental conditions selected, Pb and Cd were volatilized fairly completely as oxides in 12 hours at 1100°. Rate increased with increase of temperature up to 1320°. After adding coke, very little more Pb is volatilized. About 70% of the Cd can be volatilized from ore that has been given an oxidizing roast at 1100° for 4 hours, followed by use of coke at same temperature for 2 hours. A second test at 1000° volatilized nearly ½ the Cd and but 9.1% of the Zn in 2.08 hours. When a mass of Zn concentrate is heated externally much above 1000° in contact with coke for some hours with no coal or reoxidizing zone, loss of Zn is excessive. Using a mixture of 95% CO and 5% CO_2 effected a good removal of Cd with but little loss of Zn. **Thermodynamic Calculations. Further Theoretical Study of the Separation of Cadmium and Zinc.** Charles G. Maier. Pages 31-51. Maier discusses volatility of Zn and Cd, separation by CO-CO_2 mixtures, action of H on roasted or oxide ores and on sulphide ores. There is little difference between effect of H and CO. On basis of thermodynamic data it is recommended that H be passed over oxidized ores containing CdO at 300-500°. After reduction of easily reducible oxides, ore is heated to 800° in a closed container and Cd is volatilized with little or no gas. Pb preferably should be removed prior to this, but Cd can be volatilized to a large extent in presence of Pb. A possible ore containing sulphides of Zn, Fe, Pb and Cd heated in a stream of inert gas at 600-700° loses S from the pyrite. Galena is sublimated with an increase of temperature to 900-1000°. Replacing of inert gas with H will volatilize Cd. The theoretical basis for the process is detailed. AHE (31)

Recent Progress in the Reduction of Zinc by Natural Gas. H. A. Doerner & C. G. Maier. *American Institute Mining & Metallurgical Engineer, Contribution* No. 9, Feb. 1933, 15 pages. In large-scale tests it was found that following side reactions causing reoxidation lead to difficulties: $ZnO + CO = Zn(gas) + CO_2$ and $ZnO + H_2 = Zn(gas) + H_2O$. C formation also was troublesome, and cast-steel retorts had a short life. Methods for overcoming the difficulties were developed by small-scale experiments. A Ni catalyst promoted reduction of CO_2 and H_2O formed by the above side reactions. See also *Metals & Alloys*, Vol. 4, June 1933, page MA 198. JLG (31)

Principles of Zinc Production According to Coley Process (Die Grundlagen der Zinkerzeugung nach dem Coley-Prozess) O. W. Roskill. *Die Metallbörse*, Vol. 23, Mar. 18, 1933, pages 349-350; Mar. 25, 1933, pages 381-382. Discussion of statements in a lecture of O. Barth before the Gesellschaft Deutscher Metallhütten- und Bergleute (See also *Metall und Erz*, Vol. 30, Jan. 1, 1933, pages 1-5; Jan. 15, 1933, pages 24-30) referring to Coley process for continuous reduction of Zn ores in rotary kilns. In Wälz process (Krupp A. G.), reducing agent is coke; in the Coley, a jet of oil is decomposed in contact with hot ore yielding C in an active or nascent condition which then effects the reduction. The further addition of about 15% coal to the charge could be dispensed with from a technical standpoint. In the Wälz process, fuel and ore are heated together to the reaction temperature. In the Coley method, charge is brought up to temperature before oil is injected through a water cooled steel tube and nozzle buried beneath the surface of ore. An oxidizing atmosphere prevails in Wälz furnace, while a strictly controlled air supply is observed in Coley furnace. A reducing atmosphere is maintained while at the same time sufficient air is admitted for the oxidation of greater part of Zn vapor, CO, etc. Economic problems involved in evolution of Coley process are treated as fully as the technical questions. EF (31)

New Methods in the Metallurgy of Zinc. G. V. Ruikov. *Tzvetnuie Metallui*, No. 2, Feb. 1932, pages 176-182. (In Russian.) Loss of Zn through incomplete recovery in distillation and electrolytic processes can be considerably reduced. These losses are due largely to the presence of difficultly decomposable ferrites and silicates of Zn, and unburned ZnS. Fe, SiO_2 and Al_2O_3 also are harmful. These can be removed from concentrates, and roasting process improved by gaseous reduction combined with roasting in a suspended state. Continuous distillation directly from concentrates and its advantages are discussed. Suggested flow sheets for improved distillation and electrolytic processes are given. BND (31)

Treatment of Residues and Standardization of Zinc Distillation Processes. G. V. Ruikov. *Tzvetnuie Metallui*, No. 4, Apr. 1932, pages 456-467 (In Russian). Experiments indicated that application of gas process to residues, slags, old retorts, etc. will raise the recovery of Zn to 95-97%. BND (31)

NON-METALLIC COATINGS FOR METALS & ALLOYS (32)

Testing of Acid Resistant Coatings (Prüfung von säurebeständigem Anstrich) K. Bittner. *Farben-Zeitung*, Vol. 37, Aug. 27, 1932, page 1641. Misleading results particularly in testing acid resistant coatings are obtained due to the obstructive effect of sharp edges of the test pieces. The writer urges adoption of cylindrical steel bodies with a spherical end. The upper end has the suspension hook. In testing rod is dipped halfway 3 times into the anti-corrosive coating material and is later also submerged into the testing medium. EF (32)

Rust Protection of Iron (Roestbescherming van Ijzer) *Polytechnisch Weekblad*, Vol. 26, Jan. 14, 1932, page 21. Chiefly refers to former statements of Hebberling (*Der Bauingenieur*, Vol. 12, Aug. 12, 1931, pages 599-601) on the various rust removing methods among which sand blasting was found to be best. A ground coat of red lead and the use of linseed oil as binding agent is recommended. WH (32)

High Heat Resisting Paints for Steam Pipes, Boilers, etc. (Hochhitzebeständige Farben für Dampfleitungen, Kessel usw) *Der Maschinenmarkt*, Vol. 38, Jan. 11, 1933, page 10. Based on extensive experiments it is recommended that paint of the following composition be used: 300 g. ZnO, 300 g. $BaSO_4$, 200 g. 40% Na_2SiO_3 and 200 g. H_2O. For coloring, mineral colors should be employed exclusively. RV (32)

Protection of Underground Mains. *Gas Engineer*, Vol. 58, Apr. 1933, pages 175-176. Discussion on corrosion preventing types of coatings including baked oil paint films, bituminous cut-backs, asphalt emulsions, lacquer coatings, coal tar, "enamels," metal foils, concrete, mortar, fibre asbestos, Portland cement, and vitreous enamels. WH (32)

A Protective Wrapping for Gas Mains and Piping. *Gas Engineer*, Vol. 57, July 1932, page 404. Note on a paraffin wax amalgam unaffected by time, weather or any class of soil, always preserving its pliable nature. The pipe requires no special preparation. The coating is wrapped around the pipe as a ribbon. A table shows the recommended widths for different sized pipes. The most suitable thickness is 0.007", the breakdown voltage of which is 500 volts, while 2 thicknesses withstand 6,000 volts. WH (32)

How to Guard against, Learn, and Classify Blemishes in Iron Enamel Ware Finishes. *Domestic Engineering*, Vol. 141, Jan. 1933, pages 38-41, 111-112. Illustrated discussion with table of allowable blemishes as developed by the Sanitary Enamel Ware Association. Kz (32)

Corrosion Protection and Paint Coating. Report on Second German Corrosion Meeting and Meeting for Coating Technique (Korrosionsschutz und Anstrich Bericht über die 2.Deutsche Korrosionstagung und die Fachtagung für Anstrichtechnik) *Farben Zeitung*, Vol. 38, Oct. 29, 1932, pages 126-137. The following papers at the 2 meetings in Berlin, Oct. 1932, as well as the discussions are reviewed: (1) G. Schikorr. Chemical Reactions during the Corrosion of Metals. (2) E. K. O. Schmidt. Effect of the Carrier on the Behavior of Coatings. (3) H. Wolff. Viewpoints for Limiting the Utilization of Oil Varnish and Cellulose Varnish. (4) Salmang. Enamel as Corrosion Protection Means. (5) R. Grün. Cement and Concrete as Rust Protection Means. (6) Sachs. Rust and Corrosion Protection by Phosphate Coatings and such on Rubber Base. EF (32)

Corrosion Protection and Coating Technique (Korrosionsschutz und Anstrichtechnik) *Farbe und Lack*, Oct. 26, 1932, pages 532-535; Nov. 2, 1932, pages 544-546. Following papers are dealt with at length: (1) H. Rasquin. The Significance of Color Pigments for Anti-Rust Coatings. (2) E. Becker. On the Setting of Pigments in Varnishes. (3) Wagner. The Role of Pigments in Coating Technique. (4) W. Krummbhaar. Time and Material Saving Coatings. (5) A. V. Blom. Water-proof Coatings. EF (32)

Smoke and Heat Resistant Coatings (Rauch- und hitzebeständige Überzüge) *Brennstoff und Wärmewirtschaft*, Vol. 15, Mar. 1933, pages 50-51. Deals with non-metallic coatings applicable to about 320° C. comprising asbestos, alumina, chalk, kieselguhr, Zn white, graphite, gypsum, Mg silicate. EF (32)

Rust and Corrosion Protection by Phosphate Coatings. Corrosion Protection by Coatings on India-Rubber Base (Rost- und Korrosionsschutz durch Phosphatüberzüge) Sachs. *Oberflächentechnik*, Vol. 9, Nov. 1, 1932, pages 222-223. See *Metals & Alloys*, Vol. 4, June 1933, page MA 201. Ha (32)

Influence of Base Material on Behavior of Coats of Paint (Der Einfluss des Untergrundes auf das Verhalten der Anstriche) E. K. O. Schmidt. *Oberflächentechnik*, Vol. 9, Nov. 1, 1932, page 220. See *Metals & Alloys*, Vol. 4, June 1933, page MA 199. Ha (32)

Electrolytic Oxidation of Aluminum (Über die elektrolytische Oxydation des Aluminiums) G. Wassermann. *Die Metallbörse*, Vol. 22, Aug. 6, 1932, page 1007. X-ray investigations on commercially surface treated Eloxal revealed that oxide film represents fine grained but already crystallized γ-Al-oxide. By treatment with steam under high pressure, coating is converted into Böhmit, i.e. into $Al_2O_3.H_2O$ according to the paper before the Kaiser Wilhelm Institut für Metallforschung, June 1932. EF (32)

Technical Problems of Corrosion Protection (Technische Probleme des Korrosionsschutzes) U. Wolff. *Farben Zeitung*, Vol. 38, Oct. 15, 1932, pages 67-68. Calls attention to some unsolved problems of corrosion protection by paint coatings: (a) the question of oil demand of plastic paints (b) the water durability of films and (c) the determination of adhesive power. EF (32)

Synthetic Bake-Finishes. C. Dan Youngs. *Industrial Finishing*, Vol. 8, Sept. 1932, pages 29-30, 32. Properties, baking characteristics, and advantages of synthetic baking enamels are discussed. Author predicts wider use of synthetic finishes. JN (32)

Bake-Finishing Exterior Metal Signs. C. Dan Youngs. *Industrial Finishing*, Vol. 8, Apr. 1932, pages 50, 52. Suitable baking enamels for outdoor metal signs must be highly weather resistant, extremely flexible, non-fading as to color, and able to retard corrosion of the metal. JN (32)

Finishing Kelvinator Refrigerator Cabinets. Charles C. Thomas. *Industrial Finishing*, Vol. 8, July 1932, pages 11-14; Aug. 1932, pages 24, 26, 28. Discusses need for laboratory and production research in finishing department for securing maximum permanency and beauty of paint and lacquer finishes and describes methods for laboratory control of both process and materials in the finishing of metal cabinets. Author advocates thorough laboratory control system for guaranteeing uniformity and quality of finish. JN (32)

Oxide Film Insulation. G. Shapiro. *Electrical Review*, Vol. 111, Nov. 18, 1932, page 739. According to "Technika," Nos. 44 and 70, 1932, the Electrotechnical Research Institute, Moscow, has developed a process for depositing an oxide film on Al wire, capable of withstanding several hundred volts. Film possesses flexibility, mechanical strength, resistance to shock and friction, and good insulating, heat-resisting, and heat-conducting properties. Film is deposited by treating Al with oxidizing agents at high temperature. Chemical action is aided by anodic polarization. Oxide can be obtained in any weak acid solution and in many weak alkalies. Organic acids give best results. Superposed a.c. increases thickness of film. Coated wire was used for winding a transformer and a 3-phase induction motor with promising results. Cu conductors having a preliminary Al coating can be given an oxide film. MS (32)

CONCENTRATION (33)

The Elutriation and Microscopic Examination of Finely Ground Mineral Grains. H. K. Shirrefs & A. F. Evans. *Proceedings Australasian Institute of Mining & Metallurgy* No. 88, 1933, pages 423-477. The Andrews elutriator is described and the method of use around a mill discussed in detail. The effect of the following variables on the operation of the elutriator are discussed: kinetic effect, hindered settling effect and time of separation. The briquetting and microscopic examination of finely ground mineral grains are described in detail. AHE (33)

Recent Developments in Milling and Metallurgy. S. Power Warren. *Mines Magazine*, Vol. 23, May 1933, pages 5-7; June 1933, pages 5-7; July 1933, pages 8-12. Crushing and grinding of ores, the Andrews Kinetic Classifier, principle of operation of the Hadsell mill, and concentration of ores, including the Bendelari Diaphragm Jig, gravity concentration, and flotation are discussed. Most flotation work is done with the xanthates of the higher alcohols, such as amyl and butyl. Most of the oxidized minerals respond to the action of the soluble soaps. The mill of the Eagle-Picher Lead Company is discussed briefly and operating costs are given. Advances made in handling Zn, Pb, Cu and Au are mentioned. Kz (33)

Radium in Canada. *Engineer*, Vol. 155, Jan. 27, 1933, page 87. Briefly describes new process developed by Canadian Department of Mines which increased the grade of Ra concentrate from 1 part in 10 million to 1 part in 100,000. The concentrate is practically free from all impurities except Ba and represents 95% of the Ra present in the original ore. LFM (33)

Concentration Tests on Samples of Two Mill Products from the Kirkland Lake Gold Mining Company, Limited, Kirkland, Ont. J. S. Godard. *Canada Department of Mines, Mines Branch, Report* No. 728, 1932, pages 76-85. Flotation of return from bowl classifier in grinding circuit of cyanide mill gave 26.6% recovery of Au or 48.8% if cyanide and lime are removed by washing before flotation. Tabling gave only 21.6% recovery, but it is recommended as it can be done in cyanide solution, it eliminates filtration and avoids an excess of cyanide solution. Flotation of mill tailing gave 57.6% recovery or 67.9% after water washing. AHE (33)

Colorado's Industrial Opportunity. W. E. Greenawalt. *Mines Magazine*, Vol. 23, Jan. 1933, pages 11-16, 28; Feb. 1933, pages 11-16; Mar. 1933, pages 7-9. Includes discussion. Paper read at Annual Meeting of the Colorado Mining Association at Denver, Jan. 1933. The unfavorable mining situation in Colorado is due (1) to complex character of the ore, (2) to lack of a comprehensive metallurgical scheme for treatment of all ores, and (3) to low price of metals. The treatment of complex ores containing Au, Ag, Cu, Pb, Zn, with S, Fe and other elements by flotation or gravity concentration, the treatment of Cu concentrate by various roasting methods, leaching of roasted products, electrolytic deposition of Cu, Pb smelting, Pb refining, treating of Zn concentrate, power and fuel, and by-product H_2SO_4, phosphate and nitrate fertilizer are discussed and flow sheets are given. Kz (33)

Gravity Concentration (33b)

Notes on the Wedza Platinum Mine, Southern Rhodesia. E. Golding. *Journal Chemical, Metallurgical & Mining Society of South Africa*, Vol. 33, Dec. 1932, pages 192-195. Pt is present in concentrates mainly as sperrylite. Cooperite also is found. Concentration methods are described briefly. AHE (33b)

ADVERTISERS' INDEX

FEBRUARY ISSUE

MANUFACTURERS' LITERATURE

Stainless Steels in Dairy Industry

The National Tube Company and the American Sheet and Tin Plate Company have issued a joint booklet in the interest of stainless steels for use in the dairy and milk plant equipment fields. Illustrations of pasteurizers, receiving tanks, etc. made of stainless steel are shown, and tables designate the weights and dimensions in which 18-8 seamless pipe and tubes, sheets and light plates are available. (41)

Hydrogen Welding

A booklet from the Bundy Tubing Company gives a brief description of the more practical aspects of hydrogen welding, points out a few of its advantages and suggests possible applications. Most of the ferrous metals are adaptable to this process: low and high carbon steels, carbonized steel, high-speed steel, tungsten, molybdenum, nickel steel, etc. Gray and malleable cast iron may also be hydrogen welded by making slight variations in the welding process. (42)

Heat and Corrosion Resistant Alloys

Bulletin C1-A from the General Alloys Company illustrates a number of complex castings made from Q-Alloys. These alloys are recommended for pipe fittings, furnace parts, marine castings, valves, architectural castings, etc. (43)

Alloyed Cast Iron in Petroleum Industry

A recent bulletin issued by the International Nickel Company stresses the use of "Ni-Resist," an alloyed cast iron, for equipment in the petroleum industry. This alloy contains 14% Ni, 6% Cu and 2% Cr and possesses the required corrosion resistance for such service. (44)

Steel Sheets

The Youngstown Sheet & Tube Company has compiled a booklet which lists their products, such as sheets, plates, tubular products, rod and wire products, etc., and which contains tables showing the weights, sizes, gages and shapes in which they are available. (45)

Corrosion Protection

A booklet from E. I. du Pont de Nemours & Co., Inc. (R. & H. Chemicals Department) presents detailed information concerning an improved zinc cyanide plating process which is characterized by the use of Duozinc anodes containing a small amount of mercury. Steel products through this process are given enhanced quality and sales value by the durable, fine-grained, pleasing white coatings. (46)

Recording CO_2 Meter

A 15% saving in yearly fuel bills can be made by boosting CO_2 in flue gases from 6% to 12%. According to a folder from the Brown Instrument Company this was accomplished in one case by giving the firemen records of percent CO_2 to use as a firing guide. The CO_2 meter will also show up leaks in the fittings and baffles. (47)

Cutting Oil

Newly developed uses for their "Thred-Kut" cutting oil are discussed in a booklet received from D. A. Stuart & Company. For tough alloy steel work the oil is used full strength, but for conditions which do not require this the oil may be diluted with four parts of paraffin oil which effects a decided saving in cost. Full directions for such dilutions, and instances where they are advisable are given. (48)

Castable Refractory

"Cast-Refract," a new type of refractory with great flexibility of application, is discussed in Bulletin 303 sent out by the Quigley Company, Inc. The methods of lining coke oven doors with this material are given in detail. It may also be used for lining standpipes or for patching door linings. (49)

Zinc Die Castings

A short résumé of a talk given recently by W. M. Peirce is a feature of the most recent issue of "The Alloy Pot," published by the New Jersey Zinc Company. The uses for zinc in the automotive field are brought out, showing that considerable savings are effected by such use. (50)

Machine Gas Cutting

A most attractive 91-page book from the Air Reduction Sales Company describes their Airco-D-B machines which are available in types and sizes which meet the requirements of every shop, large or small, that can profitably use mechanical gas cutting. The range extends from the cutting of lightest gage steel plate to steel slabs, forgings and castings approaching 30" in thickness. They will cut in straight lines or in intricate contours, either vertical to the surface or at an angle. (51)

Insulation

Johns-Manville have collected their data sheets on insulation in the non-ferrous metals industries and bound them in one cover making a convenient reference booklet on the subject. Numerous tables give the heat losses from both bare and coated surfaces. One section of the booklet is devoted to their refractory cements and includes their recommendations for various installations. (52)

Stainless Steel

Bulletin 124 from the Republic Steel Corporation contains a large fund of comprehensive information on architectural applications of Enduro stainless steel, its fabrication, properties, shapes and finishes available, etc. (53)

Air Weight Controller

An air weight controller which automatically controls the weight of air being delivered to the cupola is described in a leaflet received from the Foxboro Company. It makes possible uniform melting temperatures, elimination of "burnt" iron, 10 to 40% saving in coke, longer life for cupola lining and saving in power consumption. (54)

Bonded Metals

The American Nickeloid Company has prepared a leaflet which lists their various bonded metals such as Nickeloid, nickel bonded to zinc base, Chromaloid, chromium bonded to zinc base, etc. All of these metals can be furnished in flat sheets and strips or in long continuous coils, and in any gage from .006" to .10". A list of suggested uses is given. (55)

Manganese Steel

The January issue of the Amsco Bulletin, published by the American Manganese Steel Company, features an article on their one-piece interchangeable lip manganese steel dipper. The advantages of a digging front which can be renewed in the field without riveted connections are stressed. Several unusual applications of manganese steel are described in the same issue. (56)

High Temperature Insulation

A pamphlet received from the Armstrong Cork & Insulation Company discusses the insulation of industrial heat treating furnaces. The furnaces are classified as to use, according to material they heat, according to method of movement of charge, according to fuel, and according to method of fuel utilization and the insulation of each type is discussed in detail. Sketches and diagrams assist in the explanation. (57)

Preparation of Sheet Metal for Painting

Bulletin No. 16 from the American Chemical Paint Company is a most interesting discussion of the preparation of auto bodies for finishing. The use of "Deoxidine," a cleaner which removes oil, rust, and alkalies and produces a surface to which the prime coat will adhere, is recommended. The process described is for the large production shop but can easily be adapted to small or intermittent production. (58)

Riveting Aluminum

The Aluminum Company has prepared a revised version of their booklet, "The Riveting of Aluminum and Its Alloys." This very complete little pamphlet contains chapters on the strength of riveted joints, design proportions of riveted joints, driving procedure for riveted joints, aircraft riveting, etc. Numerous tables add to its usefulness. (59)

Chromium Cobalt Tool Steel

A folder from the Detroit Alloy Steel Company is devoted to their "Krokoloy," a chromium cobalt alloy tool steel. Shop practice for users of this alloy is given, including directions for the pattern department, heat treating department and the finishing department. (60)

Bonding Material

A leaflet from the Harbison-Walker Refractories Company recommends Harwaco bond for all fireclay brick laying. Due to its great plasticity film joints may be as thin as desirable. The bond sets to almost iron hardness and retains its great strength at all temperatures, thus giving the furnace structure longer life. (61)

Machining Tools

The Carboloy Company, Inc. suggests four plans for purchasing Carboloy tools: as finished tools, milled and brazed tools, tools "brazed only," or Carboloy blanks only. They have published a booklet which explains the four plans with a brief summary of their advantages and limitations. (62)

Heat Treating Furnaces

A recent folder from the Surface Combustion Corporation illustrates a number of sizes and types of furnaces for heating operations including gas-fired immersion tank furnaces, small oven furnaces for tool hardening, crucible furnaces and pot hardening furnaces. (63)

Thermit Welding

A new illustrated booklet published by the Metal & Thermit Corporation describes thermit welding, an alumino-thermic process. The actual welding of street railway and railroad track and the repair of large machine parts, huge marine castings, and similar articles are covered thoroughly. Particular attention is given to the economy and permanency of such repairs and actual cost data are given. (64)

Regulators

Catalog Part 4 from the Taylor Instrument Companies is devoted to their regulators for the control of temperature, time, temperature-and-time, and pressure. The catalog contains full descriptions and illustrations of all types of regulators. (65)

Circuit Breaker

An oil-blast circuit breaker for steel mill motor starting and "jogging" service is described in a leaflet received from the General Electric Company. It is designed for the most difficult service to which a breaker can be subjected and so is suitable for any other difficult industrial application. (66)

Corrosion-Resisting Alloy Steels

Bulletin 171-A from the Duriron Company, Inc. gives physical and chemical data on their Durimet and Durco alloy steels. It includes a table showing the resistance of these steels to various chemicals and a short discussion of their heat treatment, welding and machining. (67)

Magnesium Alloys

A small leaflet from the Dow Chemical Company contains tables showing the chemical composition of the various Dowmetal alloys, their physical constants and their mechanical properties. Uses are suggested for the various types. (68)

Phosphor Bronze

The Phosphor Bronze Smelting Company has issued their price list No. 29 which includes their S grade for bearings in the form of castings, the B grade for machinery, gears, etc., the D grade for the same purpose as B, though much harder, and F for purposes where great weight is to be sustained with slow motion. (69)

Hardening

A leaflet from Leeds & Northrup Company discusses their new triple-control Hump hardening method. Positive control of the quench point, the rate of heating and the furnace atmosphere contribute to the economy of the method. Frequently all refinishing for surface flaws can be omitted since the work comes from the furnace clean. (70)

Aluminum Finish

A recent bulletin from Quigley Company, Inc. recommends the use of their Triple-A No. 44 Aluminum Vehicle for protecting and decorating steelwork, bridges, cranes, fences, pipe lines, etc. This coating is a special black, chemically neutral, waterproof, anti-corrosive vehicle, to which aluminum powder is added, which thus furnishes a black base and aluminum surface in one operation. It may be applied on damp surfaces, withstands temperature changes and will neither chip nor peel. (71)

Making Steel

An interesting little booklet issued by the Inland Steel Company is entitled "Making Steel." The story is briefly and simply told, technical terms being avoided. (72)

Shipping Efficiencies

Acme Steel Company have recently completed the production of a new set of literature covering efficiencies and economies effected in preparing boxes and loads for shipment. Many different types of shipping methods are covered—from strapping cartons, to making a unit load of a thousand pieces of steel tubing. (73)

Refractory Cement

A leaflet from Charles Taylor Sons Company pictures the results of a test performed on five brands of refractory cement which were trowelled on a tile and fired at 2700° F. Uses suggested for their Tayco brand are: trowelled joints, dipped joints, wash coatings, patching. (74)

Arc Welding

An interesting pamphlet prepared by The Hobart Brothers Company outlines a few of the modern applications of electric arc welding in many industries, and includes a catalog section showing the latest developments in arc welding equipment. (75)

Inhibitors

Directions for its use are included in a booklet from the Grasselli Chemical Company devoted to the Grasselli 3 inhibitor. A table recommends strengths for pickling various grades of steel. Grasselli 3 is a powdered inhibitor; for those who prefer a liquid inhibitor Grasselli 8 is recommended. (76)

Objectives and Eyepieces for the Microscope

A 20-page booklet from Carl Zeiss, Inc. discusses their objectives and eyepieces giving prices and illustrations. (77)

Cadmium Plating

The December issue of The Udylite News, published by the Udylite Process Company illustrates the use of their plating process on the suspension members of filing cabinet drawers, in floodlights and snap fasteners. (78)

METALS & ALLOYS, 330 West 42nd St., New York, N. Y.

I should like a copy of each piece of Manufacturers' Literature listed below.

....

Name..

Position.. Firm..

Street and Number..

City.. State..

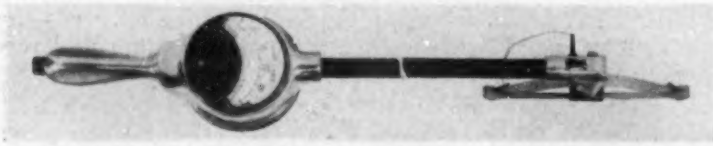
NEW MATERIALS and EQUIPMENT

Electrode for Welding Cast Iron

An electrode for welding cast iron by the shielded arc process is announced by The Lincoln Electric Company, Cleveland, Ohio. The electrode, known as "Ferroweld," has a steel core surrounded by a heavy flux coating which protects the arc from gases injurious to the weld which are present in the atmosphere. One of the outstanding advantages claimed for "Ferroweld" is the remarkably low heat with which it can be used, thus reducing the possibility of cracking. The electrode is manufactured in only one size—⅛"—and is used with approximately 80 amperes of current. Welding is done intermittently, not over a 3 inch bead being laid down at one time. As each bead is welded it is peened lightly, thoroughly cleaned and allowed to cool somewhat before the next bead is deposited. Due to the extremely low current with which it is used the hardening effect ordinarily present along the line of fusion is materially reduced. Thus the weld is more machinable than most cast iron welds.

Roll Surface Pyrometer

For measuring surface temperature of revolving cylinders, this new self-contained thermoelectric pyrometer, built by Illinois Testing Labs., Chicago, Ill., has a ribbon type thermocouple held in a resilient bow-shaped assembly mounted at one end of a supporting arm of any desired length up to 48". A grooved carbon block attached to the bow limits the tension on the thermocouple ribbon, so that no matter how much pressure the operator exerts in applying the assembly



to the surface of a roll, the ribbon will not be unduly stressed. The bow assembly can be clamped in any desired position, to reach hard-to-get-at surfaces. The millivoltmeter has a 3½" scale which may be graduated 0-600, 0-800 or 0-1000° F. Internal cold-junction compensation is optionally available.

New Refractory

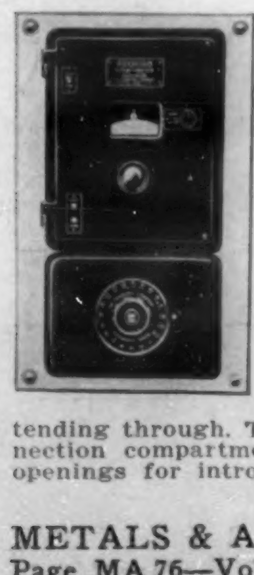
A rather remarkable refractory is being marketed by the Electro Refractories & Alloys Corp., Buffalo, N. Y. The material is called Tercod, and is furnished in standard brick sizes and special shapes to order. It is a glazed refractory composed mainly of silicon carbide, with a carbon bond. The interesting properties claimed for Tercod are:

1. Exceptionally low coefficient of thermal expansion—.0000027/°C. This is half the expansion of fireclay, mullite, silicon carbide, etc., and one-ninth that of silica brick.
2. High strength at all temperatures—no melting point. The carbon bond of Tercod gives rigidity up to the dissociation temperature of silicon carbide, which is about 4000°C.
3. High thermal conductivity—.029 in c.g.s. units at 1350°C. This is higher than regular silicon carbide.
4. High electrical conductivity approaching that of carbon. The resistivity in ohms per cc. ranges from .012 cold, to .0066 at 1500°C.
5. Inert to practically all metals except steel and nickel. Tercod has proven successful in melting non-ferrous alloys and gray iron. It does not withstand the action of steel and nickel since these metals have a high affinity for carbon.
6. Inert to acid and neutral slags and fluxes. Is attacked by basic slags and fluxes.

The refractory is said to have proven especially suitable for electric metal melting furnaces, where high temperatures and quick chilling require a non-spalling refractory with good mechanical strength. In iron, steel, and nickel furnaces Tercod gives 10 to 20 times the life of other refractories in roof and door locations.

Indicating Potentiometer Pyrometer

The new indicating pyrometer, a development of the Foxboro Company, Foxboro, Mass., is easy and convenient to use since all the adjustments are centrally located on the front cover plate of this new instrument, which employs the potentiometer principle of temperature measurement. The galvanometer pointer swings just above the temperature dial and is brought to balance at the same hair-line index which marks the temperature measurement. The hair-line is part of a glass window through which both pointer and scale are viewed at the same time. Thus, balancing and reading are practically one operation. Scale length on the 6" dial is 17", permitting fine divisions, and plain black figures add to the readability. The double-suspension galvanometer is designed to withstand industrial use without impairing accuracy or sensitivity. The new universal moisture-proof case, said to be unique in design, may be either surface or flush mounted. When flush mounted, a clamping device holds the instrument tight to the panel without screws or bolts extending through. Thermocouple leads are brought to a connection compartment, sealed from case interior, and with openings for introduction of conduit if desired.

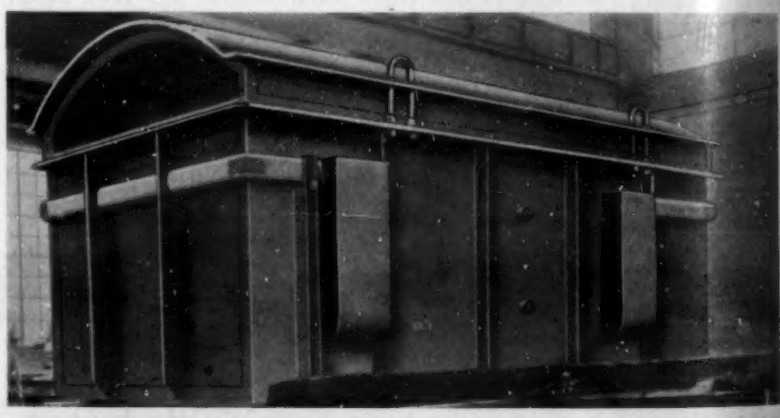


Casting Washer

New equipment to clean steel castings ranging in size from small gears to large revolving frames weighing 15 tons, by the application of water under pressure from 300 to 400 lbs./in.², has been installed at Bucyrus-Erie Co., South Milwaukee. Previously the core sand, core rods and gaggers from these steel castings were removed by a crew of men using pneumatically operated pokeout bars, a slow and dirty process involving many hours of tedious chipping and cutting. Now the same work is accomplished with only 3 men, the craneman, hookman and room operator, under conditions that eliminate all dust and dirt, and at a very great saving in time. A 15 ton casting previously requiring about 35 hours to clean now can be finished in from 1½ to 2 hours. This casting washer was designed and built by the Pangborn Corp., Hagerstown, Md., and consists of a steel room 25 feet square on the inside and having an overall height from the floor level of 17 feet 9 inches. Two front doors are operated by hydraulic cylinders and provide an opening 15 feet wide and 16 feet high for moving castings in and out of the room. An opening in the top of the room permits the use of a traveling crane in placing the work on the turntable in the center, and is a three panel, sliding type door driven by a 5 horsepower motor riding on the front panel. A 12 foot rotating table in the center of the room, fitted with 12 equally spaced T-slots as well as a number of holes for stanchions, chains, etc., is used to hold the work. The turntable has a capacity of 50 tons and is operated by a 10 horsepower waterproof motor. It may be rotated in either direction, to permit the stream of water to strike the work at the angle desired by the operator. The two operating stations are located at one corner of the room, one above the other. Shatterproof windows located directly above the nozzles permit the operator to see the work in the room and to direct his nozzles where required. At both stations the operator has control of the water pump, movement of the rotary table and nozzles, and the interior lights. As water is reused again and again the consumption cost is very little.

Lectronealer

To meet the increasing need for suitable equipment for properly bright annealing both ferrous and non-ferrous products, as well as for other processes demanding controlled heat treating, the Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa., has developed and perfected the Lectronealer, built in 2 types, the circular and the rectangu-



lar. The claimed advantages are: It is of the removable hood type—with the heating elements in the hood. Many patented features are incorporated in its construction. The hoods are readily removable and conveniently portable, as are the bases upon which the charge is stacked, several of which can be used in connection with a single hood. These bases can be located centrally or at convenient points in the plant and the hood transferred from place to place. This of course permits a cycle of operation in which one base is loaded with the material to be treated, the hood placed over the charge, the desired heating given under precise control and the hood then removed to another loaded base for heating while the previous load is cooling. The cooling base—if conditions demand—is covered with a cooling cover either before or after the heating. The egress of furnace atmosphere and the ingress of air are prevented by means of a patented double seal arrangement. The inner seal, the one exposed to the furnace temperature and atmosphere, is of sand while the outer seal may be water, a high flash oil such as palm oil, or pitch—depending on the type necessary for the work being done. The outer seal may be water cooled or steam heated as needed. One of the most important features is the patented diffusing device for controlling the furnace atmosphere. This part of the equipment insures a complete and equal distribution of the furnace atmosphere throughout the furnace. The Lectronealer is compact and built entirely at the factory. A completely wired switchboard with instruments is supplied, ready to connect direct to the standard shop supply. It is adapted to all types of annealing, normalizing, nitriding, cyaniding, carburizing, drawing and tempering. It is particularly adapted to the heat treatment of sheets. The equipment supplied includes a multi-voltage transformer so that the power input can be adjusted to give the proper operating temperature as well as to give the most economic overall operating efficiency for the particular operation at hand. The temperature of the furnace is automatically controlled and the construction is such that there is minimum temperature variation throughout the furnace. Consistent and dependable results are had with low maintenance costs.